Table 4-1. Dwelling Units and Population within 1,250 Feet from Pipeline (Houston to El Paso)

Milepost		Population Density[1]	Population [2]	Location
From	To			
0.0	1.0	Low	- 0 -	1-mile segment - GATX Terminal/industrial area
1.0	5.0	High	>3,600	4-mile segment - Northern GATX Terminal/industrial area; Galena Park; Jacinto City; and Holiday Forest and Songwood subdivisions
5.0	6.0	Moderate	63	1-mile segment - Herman Brown Park and Wood Bayou Subdivision
6.0	7.0	Moderate	30	1-mile segment - Wallisville Gardens Subdivision
7.0	10.0	High	568	3-mile segment - HL&P Greens Bayou Station and Ralston Acres, Houmont Park, and Green River subdivisions
10.0	27.0	High	>26,000	17-mile segment - Brock Park and Parkwood East, Lake Forest Estates, Glenwood Forest, Kentshire Place, Park North, Scenic Woods, Fontaine Place, Sherwood Place, Oakwilde, Melrose Place, Willow Run, Heather Glen, West Mount Houston, Inwood North, and Inwood North Estates subdivisions
27.0	28.0	Low	3	1-mile segment - Undeveloped urban land
28.0	34.0	High	>11,000	6-mile segment - Rolling Fork, Arbor Vineyards, Willowbridge, Winchester Country, Steeplechase, Steeplechase Park, and Crossroads subdivisions
34.0	35.0	Low	- 0 -	1-mile segment - Industrial/commercial area
35.0	36.0	High	487	1-mile segment - Northmead Village Subdivision
36.0	37.0	Moderate	95	1-mile segment - Aberdeen Trails Subdivision
37.0	74.0	Low	100	38-mile segment - Western Harris County to Austin County
74.0	75.0	Moderate	55	1-mile segment - Vicinity of Bleiblerville
75.0	123.0	Low	121	48-mile segment - Central Waller County to Eastern Bastrop County
123.0	126.0	Moderate	402	2-mile segment - Indian Lake Estates
126.0	152.0	Low	75	26-mile segment - Unincorporated Bastrop County
152.0	155.0	High	458	3-mile segment - Stony Point and East Travis Trails subdivisions
155.0	160.0	Low	56	5-mile segment - Unincorporated Travis County
160.0	161.0	Moderate	139	1-mile segment - Pilot Knob
161.0	163.0	Low	27	2-mile segment - Unincorporated Travis County
163.0	172.0	High	>7,700	9-mile segment - Onion Creek Forest, Silverstone, Indian Hills, Meadow Creek, Park Ridge, Buckingham Estates, Parkwood, Tanglewood Forest, Shiloh, Southwest Oaks, Cherry Creek, Sendera Oaks, and Sendera Glen subdivisions
172.0	173.0	Low	- 0 -	1-mile segment - Village at Western Oaks (undergoing development)
173.0	174.0	High	>514	1-mile segment - Circle C Ranch
174.0	176.0	Moderate	241	2-mile segment - Unincorporated Travis County and Lookout Point and Lewis Mountain Ranch subdivisions
176.0	177.0	Low	31	1-mile segment - Unincorporated Travis County

Table 4-1. (Continued)

Milepost		Population Density [1]	Population [2]	Location
From	To			
177.0	178.0	Moderate	105	1-mile segment - Unincorporated Travis County and Cedar Valley Subdivision
178.0	179.0	Low	36	1-mile segment - Unincorporated western Travis County
179.0	180.0	Moderate	65	1-mile segment - Unincorporated western Travis County
180.0	695.0	Low	524	530-mile segment - Hays County to El Paso Terminal

[1] Dwelling units within 1,250 feet from the pipeline per linear mile. Low = 0-20/mile, Moderate = 21-100/mile, High = >100/mile.

Note: Other subdivisions and neighborhoods in the Austin area beyond 1,250 ft distance include: Dove Springs, Beacon Ridge, Cortina, Deer Park at Maple Run, Maple Run No. 5, Mathews Lane, Onion Creek Plantation, Park Ridge, Park Wood, Plantation Oaks, Salem Walk, South Creek, Whispering Oaks, and Woodstone Village.

[2] Estimated population estimates within 1,250 feet from the pipeline. (Refer to Appendix 4A, Table 4A-2.)

Note: Population numbers differ from total amounts stated in text due to rounding.

Table 4-2. Population by County – Estimated 1998 and Projections for 2020 and 2030

				Projected Annual Population Change		Projected Annual Percent Change	
	1998	2020	2030	1998 - 2020	2020 - 2030	1998 - 2020	2020 - 2030
Harris	3,178,995	4,000,414	4,307,663	37,337	30,725	1.2	0.8
Waller	29,183	47,616	60,729	838	1,311	2.9	2.8
Austin	22,823	36,278	42,858	612	658	2.7	1.8
Fayette	21,768	28,509	31,544	306	304	1.4	1.1
Bastrop	48,929	97,916	125,426	2,227	2,751	4.6	2.8
Travis	699,981	1,145,909	1,401,692	20,269	25,578	2.9	2.2
Hays	86,475	154,296	191,951	3,083	3,766	3.6	2.4
Blanco	7,797	15,824	21,150	365	533	4.7	3.4
Gillespie	20,386	33,985	41,593	618	761	3.0	2.2
Mason	3,679	3,605	3,667	-3	6	-0.1	0.2
Kimble	4,269	5,668	7,173	64	151	1.5	2.7
Menard	2,360	2,419	2,442	3	2	0.1	0.1
Schleicher	3,372	4,371	4,776	45	41	1.3	0.9
Crockett	4,711	6,701	7,718	90	102	1.9	1.5
Reagan	4,229	6,637	7,122	109	49	2.6	0.7
Upton	4,030	6,039	6,290	91	25	2.3	0.4
Crane	4,583	6,265	6,501	76	24	1.7	0.4
Ector	124,139	142,539	145,399	836	286	0.7	0.2
Ward	12,761	16,190	16,523	156	33	1.2	0.2
Reeves	15,307	20,966	21,972	257	101	1.7	0.5
Culberson	3,302	5,275	5,800	90	53	2.7	1.0
Hudspeth	3,475	4,569	5,126	50	56	1.4	1.2
El Paso	688,626	1,021,886	1,178,165	15,148	15,628	2.2	1.5
Total	**4,995,180**	**6,815,897**	**7,645,310**				

Population estimates were acquired from the Texas State Data Center (1999) for those counties crossed by the Longhorn Pipeline. Current population numbers used were based on estimates as of January 1, 1998 (similar estimates for 1999 were not available). Population projections were compiled for 2020 and 2030 (estimates beyond 2030 were not available). Methodology used in estimating current (1998) population levels was based on 1990 Census data and factors that are known to influence population changes. A net migration pattern scenario that was based on 1990 through 1996 migration patterns was used to report estimated future population levels. The scenario was selected because it is particularly useful for those counties with post-1990 patterns that are substantially different than those of the 1980s.

Table 4-3. Summary of Sensitive Receptors by Milepost Location within 1,250 Feet of the Pipeline for GATX to El Paso Terminal

	Population Based Areas		Hospitals and Health Care Facilities (Mileposts)	Overnight Lodging (Mileposts)	Correctional Facilities (Mileposts)	Land Uses		Parks and Natural Areas (Mileposts)
	21 or More Dwelling Units per Mile (Mileposts)	Schools and Day Care Facilities (Mileposts)				Energy Industry Land Uses (Mileposts)	Other Incompatible Industries (Mileposts)	
	1.0 - 6.0 7.0 - 27.0 28.0 - 34.0 35.0 - 37.0 74.0 - 76.0 123.0 - 126.0 152.0 - 155.0 160.0 - 161.0 163.0 - 172.0 173.0 - 176.0 177.0 - 178.0 179.0 - 180.0	11.3 12.0(a) 12.0(b) 13.7 14.3(a) 14.3(b) 14.3(c) 14.3(d) 14.3(e) 17.1 20.5 20.9 21.1 21.7 24.5 24.6 25.5 26.3 27.8 29.7 30.9 31.1 32.0 35.2 163.1 165.5 168.9 167.2 167.4	3.6 18.8 21.2 168.2	34.5 165.9	None	0.0 - 1.1 7.5 - 8.2 33.8 - 34.1	None	1.7 4.1 - 4.2 4.6 - 5.1 9.7 - 10.4 16.3 17.9 22.6 25.4 25.6(a) 25.6(b) 28.2 28.7 31.2 32.3 35.0 93.8 127.5 - 128.8 133.9 - 134.3 162.9 163.8 164 165.5 167.9 169.3 170.7 173.1 194.5 - 197.0
Total Number of Receptors/Miles	56 miles	29 facilities	4 facilities	2 facilities	No facilities	3 areas	No facilities	26 facilities

Note: Dwelling unit analysis is based on 21 or more units per linear mile. All values expressed in full linear miles.
Milepost locations expressed as (a), (b), (c), (d), (e) reflect multiple sensitive receptors at the same approximate location along the pipeline.
Energy industry land uses do not include oil and gas field operations.
Overnight lodging includes hotels, motels, and recreational vehicle parks.

Table 4-4. Sensitive Receptors (Excluding Schools) – Houston Metropolitan Area

Parks and Recreational Areas			
Sensitive Receptor	**Location**	**Distance from Pipeline (feet)**	**Mileposts**
Smith Park	Galena Park	2,100	1.7
Herman Brown Park	East Houston	Traversed by ROW	4.1 to 4.2
			4.6 to 5.1
Brock Park	John Ralston Rd.	Traversed by ROW	9.7 to 10.4
James Driver Park	US 59 Frontage Rd.	400	16.3
Keith Weiss Park	Aldine and Hartwick	Adjacent to ROW	17.9
Commissioner Lee Park	Ella Blvd.	Traversed by ROW	22.6
Inwood North Forest Recreation Center I	Enchanted Forest Rd.	1,000	25.4
Inwood North Forest Recreation Center II	Maywood Forest Rd.	1,100	25.6
Inwood Forest Recreation Center	W. Mount Houston	Adjacent to ROW	25.6
Rolling Fork Park and Recreation Center	Rodney Ray Blvd.	Adjacent to ROW	28.2
Park and Community Recreation Center	Park Blvd.	Adjacent to ROW	28.7
Park Winchester Swim and Tennis Club	Rio Grande	700	31.2
Neighborhood Park [1]	12000 block of Steepleway Blvd.	940	32.3
Neighborhood Park [1]	Copper Grove Subdivision	830	35.0
Health Care Facilities			
Greenway Manor Personal Care	3625 Hopper Rd	600	18.8
Gulf Bank Medical Center	302 W. Gulf Bank	1,200	21.2
Medical Center of East Houston	I-10 Frontage Road	300	3.6
Overnight Lodging Facilities			
Intown Suites	8800 block of SH 6	Adjacent to ROW	34.5

[1] Unnamed neighborhood park.

Table 4-5. Schools and Day Care Facilities – Houston Metropolitan Area

School	Enrollment	Grades	School District	Proximity to Pipeline (feet)	<1,250	>1,250	Milepost
Bang Elementary 8900 Rio Grande	1,000	PK-5	Cy-Fair ISD	600	X		31.1
Brentwood Children's Academy Steeple Park Rd.	N/A	Day Care	Private	300	X		32.0
Calvary Lutheran School 10635 Homestead Rd	40	Day Care	Private	240	X		14.3
Carroll Academy for International Study 423 W. Gulfbank	1,100	PK - 4	Aldine ISD	480	X		20.9
Children's Rainbow Academy Day Care 1391 W. Gulfbank Rd.	N/A	Day Care	Private	600	X		21.7
Cook Jr. High 9111 Wheatland	1,300	6 - 8	Cy-Fair ISD	Adjacent to ROW	X		30.9
Cypress Fairbanks High School 9811 Huffmeister	2,900	9 - 12	Cy-Fair ISD	1,300		X	35.2
Eiland Elementary 6700 N. Klein Circle Dr.	560	PK - 5	Klein ISD	300	X		26.3
First Metropolitan Church Infant Development Center and Christian Academy 8870 Sam Houston N. Tollway	55	Day Care	Private	Adjacent to ROW	X		29.7
Fonwood Elementary 10719 Seneca	1,016	K - 5	North Forest ISD	Adjacent to ROW	X		14.3
Frazier Elementary 8300 Little River Dr.	525	K - 5	Cy-Fair ISD	1,000	X		27.8
Greater Progressive Baptist Church School 9847 Mesa Dr.	N/A	Day Care	Private	360	X		12.0
Keeble Primary 203 W. Gulfbank	577	PK	Aldine ISD	1,000	X		20.5
Kinder Care 8703 Antone Dr.	83	Day Care	Private	300	X		25.5
Kirby Middle School 9709 Mesa Dr.	950	6 - 8	North Forest ISD	600	X		12.0
Klein Intermediate 4710 W. Mt. Houston Rd.	1,100	6 - 8	Klein ISD	100	X		24.6

Table 4-5. (Continued)

School	Enrollment	Grades	School District	Proximity to Pipeline (feet)	<1,250	>1,250	Milepost
Langstead Primary 7201 Langley Rd.	498	PK	North Forest ISD	Adjacent to ROW	X		14.3
Miss Lucy's Early Childhood Center 10620 Homestead Rd	N/A	Day Care	Private	600	X		14.3
Nitsch Elementary 4702 W. Mt. Houston Rd.	840	PK - 5	Klein ISD	300	X		24.5
Northeast Christian School 7300-1/2 Langley	43	Day Care	Private	Adjacent to ROW	X		11.3
Northwood Middle School 10750 Homestead	650	6 - 8	North Forest ISD	Adjacent to ROW	X		14.3
Rogers Elementary 10550 J. L. Reaux	683	K - 5	North Forest ISD	900	X		13.7
Sweetwater Christian School/Day Care 8600 Sweetwater Ln.	580	Day Care	Private	Adjacent to ROW		X	21.1
Worsham Elementary 3007 Hartwick	800	PK - 4	Aldine ISD	1,300		X	17.1

N/A = Not Available
PK = Pre-kindergarten
K = Kindergarten

Source: American School Directory, 1999
Key Maps, 1998

Note: Cy-Fair ISD refers to the Cypress-Fairbanks Independent School District.

Table 4-6. Schools and Day Care Facilities – Austin Metropolitan Area

School	Enrollment	Grades	School District	Proximity to Pipeline (feet)	<1,250	>1,250	Milepost
Bailey Middle School 4020 Lost Oasis Hollow	1,687	6 – 8	Austin ISD	12,700		X	171.8
Bedichek Middle School 6800 Bill Hughes Rd.	1,200	6 – 8	Austin ISD	2,600		X	167.5
Boone Elementary 8101 Croftwood Rd.	900	K – 5	Austin ISD	3,000		X	170.3
Bowie High School 4103 Slaughter La.	3,100	9 – 12	Austin ISD	3,600		X	188.1
Bright Horizons Family Center Escarpment and Davis Rd.	Under construction	Day Care	Private	1,700		X	172.5
Christ Community Christian School 8210 S. First St.	N/A	Day Care	Private	2,000		X	167.2
Hillcrest Elementary 6910 E. William Cannon Dr.	400	4 – 6	Del Valle ISD	300	X		163.1
Kiker Elementary 5913 La Crosse Ave.	1,200	K – 5	Austin ISD	5,500		X	173.3
Kocurek Elementary 9800 Curlew	887	PK – 5	Austin ISD	7,000		X	170.1
Legacy Oaks Christian Schools 7915 Manchaca Rd.	N/A	Day Care	Private	1,100	X		168.9
Langford Elementary 2206 Blude Meadow	850	PK – 5	Austin ISD	1,250	X		165.5
Mills Elementary 6201 Davis Ln.	535	K – 5	Austin ISD	1,800		X	172.7
Nana's Day Care 7806 S. First St.	N/A	Day Care	Private	270	X		167.2
Odom Elementary 1010 Turtle Creek Blvd.	730	K – 5	Austin ISD	6,400		X	167.6
Palm Elementary 7601 Dixie Dr.	675	PK – 5	Austin ISD	1,880		X	164.0
Pleasant Hill Elementary 6405 Circle S Rd.	670	PD – 5	Austin ISD	4,100		X	167.0

Table 4-6. (Continued)

School	Enrollment	Grades	School District	Proximity to Pipeline (feet)	<1,250	>1,250	Milepost
Popham Elementary 7014 Elroy Rd.	925	PK – 3	Del Valle ISD	2,000		X	158.0
Widen Elementary 5605 Nuckols Crossing	1,080	PK – 5	Austin ISD	6,500		X	164.2
Williams Elementary 500 Mairo Dr.	950	PK – 5	Austin ISD	1,140	X		167.4

N/A = Not Available
PK = Pre-kindergarten
K = Kindergarten

Source: American School Directory, 1999
Key Maps, 1998

Note: Cy-Fair ISD refers to the Cypress-Fairbanks Independent School District.

Table 4-7. Non-school Sensitive Receptors – Austin Metropolitan Area

Parks and Recreational Areas			
Land Use Feature	**Location**	**Distance from Pipeline (feet)**	**Mileposts**
McKinney Falls State Park	N/A	200	162.9
Neighborhood Park [1]	Vicinity of Marble Creek Crossing	Adjacent to ROW	163.8
Onion Creek Greenbelt	Onion Creek Dr.	Traversed by ROW	164.0
Kendra Page Park	2203 Blue Meadow	900	165.5
Dittmar Recreation Center and Park	1000 block of W. Dittmar Rd.	700	167.9
Neighborhood Park [1]	Cameron Loop Rd. and Fort Sumpter	700	169.3
Karst Nature Preserve	3900 block of Deer Lane	100	170.7
Circle C Metropolitan Park	Circle C Development	500	173.1
Health Care Facilities			
The Brown Schools Rehabilitation Center	1106 W. Dittmar Rd.	Traversed by ROW	168.2
Overnight Lodging Facilities			
Lone Star RV Resort	6900 block of I-35 frontage road	1,100	165.9

[1] Unnamed neighborhood park.

Table 4-8. Dwelling Unit and Population Estimates – El Paso Laterals

	Fort Bliss Alternative		Montana Ave. Alternative	
	Number of Dwellings [1]	**Estimated Population[2]**	**Number of Dwellings [1]**	**Estimated Population[2]**
Del Este Apartments	N/A	N/A	96	318
Del Este II Apartments	N/A	N/A	184	609
Carlsbad Mobile Home Park	N/A	N/A	75	248
Digger Pines Apartments	N/A	N/A	80	265
Las Palmas Subdivision (estimated to be 60 percent occupied)	N/A	N/A	200	662
Palm Desert Subdivision (estimated to be 30 percent occupied)	N/A	N/A	80	265
Hueco Mountain Village (estimated to be 15 percent occupied)	N/A	N/A	30	99
Unnamed mobile home park (west of Turf Lane)	N/A	N/A	60	199
Unnamed mobile home park (east of Turf Lane)	N/A	N/A	25	83
Quail Run Mobile Homes	N/A	N/A	12	40
Butterfield Square Subdivision	70	232	12	40
Desert Park Oasis	N/A	N/A	30	99
Other single-family dwellings			250	828
Total	**70**	**232**	**1,134**	**3,755**

N/A = Not Applicable
[1] Within 1,250 feet from Pipeline Centerline.
[2] Population estimated from 3.31 persons per household (1990 Census Bureau).

Table 4-9. El Paso Schools – Comparison of Montana Avenue and Fort Bliss Routes

School	Enrollment	Grades	School District	Distance (feet) from Pipeline	
				Fort Bliss Pipeline	Montana Ave. Laterals
Cielo Vista Elementary 9000 Basil Ct.	300	PK - 5	Ysleta ISD	37,000	2,800
East Montana Middle School 3490 Ascencion Blvd.	1,200	5 - 8	Clint ISD	13,500	14,500
Edgemere Elementary 10300 Edgemere St.	991	K - 6	Ysleta ISD	35,000	3,100
Montana Vista Elementary 14900 Greg Dr.	500	3 - 4	Clint ISD	14,000	15,000
Mountain View High School 14964 Greg Dr.	798	9 - 12	Clint ISD	15,500	15,500
Pebble Hills Elementary 11145 Edgemere St.	1,100	K - 6	Ysleta ISD	35,000	3,000
Unnamed Elementary School* Lee Trevino Dr. and Montana Ave.	900 - 900	K - 8	Ysleta ISD	34,000	>1,250

PK = Pre-kindergarten
K = Kindergarten

Source: American School Directory, 1999
Escabar, 1999
Mapsco, 1998
*Under construction

Table 4-10. Major and Minor Aquifers Crossed by the Longhorn Pipeline System Route with General Characteristics

Aquifer	Age	Lithology
Gulf Coast Aquifer System (Major)	Tertiary-Quaternary	Sand, silt clay, and gravel
Brazos River Alluvium Aquifer (Minor)	Quaternary	Unconsolidated alluvium including sand, gravel, with interbedded silts and clays
Sparta Aquifer (Minor)	Tertiary	Interbedded sands and clays
Queen City Aquifer (Minor)	Tertiary	Sand, loosely cemented sandstone with interbedded clay
Carrizo-Wilcox Aquifer System (Major)	Tertiary	Sand, sandstone, clay, silt, lignite, gravel
Colorado River Alluvium (Proposed minor aquifer)	Quaternary	Unconsolidated alluvium including sand, gravel, with interbedded silts and clays
Edwards Aquifer (Balcones Fault Zone) (Major)	Cretaceous	Limestones and dolomites (cavernous, vugular, fractured)
Trinity Aquifer (Major)	Cretaceous	Limestone and dolomite, gravel, and conglomerate with interbedded clay; sand with interbedded clay
Hickory Aquifer (Minor)	Cambrian	Basal Paleozoic sandstone, medium to coarse grained, hematite cemented
Ellenburger-San Saba Aquifer (Minor)	Cambrian - Ordovician	Limestone and dolomite, fractured
Marble Falls Aquifer (Minor)	Pennsylvanian	Limestone and dolomite
Edwards-Trinity (Plateau) Aquifer (Major)	Cretaceous	Limestone, dolomite, and sandstone
Cenozoic Pecos Alluvium Aquifer (Major)	Tertiary	Unconsolidated sand, silt, gravel, with interbedded clays and playa deposits
Dockum Aquifer (Minor)	Triassic	Sandstone, shale and conglomerate
Capitan Reef Complex Aquifer (Minor)	Permian	Reef limestone and dolomite
Rustler Aquifer (Minor)	Permian	Limestone, siltstone, sandstone, and clay
Hueco Bolson Aquifer (Minor)	Tertiary	Unconsolidated sand, silt, gravel, with interbedded clays and playa deposits
Lipan Aquifer	Tertiary	Unconsolidated conglomerate, gravels, sands, silt, and interbedded clay

Source: Texas Water Development Board and Bureau of Economic Geology

Note: Although not designated a major or minor aquifer by TWDB, the "Colorado River Alluvium Aquifer," primarily in Bastrop and Fayette counties, has been identified as a significant and sensitive hydrogeologic unit and is discussed in this environmental assessment.
The Lipan Aquifer is not along the existing Longhorn Pipeline System route but is included in this discussion because it occurs along the Aquifer Avoidance/Minimization Route Alternative (discussed in Chapter 9).

Table 4-11a. Public Water Supply Systems (Ground Water) in the Vicinity (<2.5 miles) of the Longhorn Pipeline System

Public Water Supply System	Aquifer Used	% Total Supply Surface Water	% of Total Supply Groundwater
City of Galena Park	Gulf Coast	41	39
Jacinto City	Gulf Coast	57	43
City of Houston	Gulf Coast	62	38
City of Bastrop	Colorado River Alluvium	0	100
City of La Grange	Carrito-Wilcox	0	100
City of Smithville	Carrito-Wilcox	0	100
City of Winchester	Colorado River Alluvium	0	100
Aqua Water Supply Corp.	Carrizo-Wilcox	0	100
City of Cedar Creek	Colorado River Alluvium	0	100
Johnson City	Ellenburger-San Saba	60	40
City of Big Lake	Edwards-Trinity	0	100
Colorado River MWD* (Pyote Field)	Edwards-Trinity, Cenozoic Pecos Alluvium	0	100
City of El Dorado	Edwards-Trinity	0	100
City of Odessa	Edwards-Trinity	82	18
City of Pecos	Dockum Aquifer and Cenozoic Pecos Alluvium	0	100
City of El Paso	Hueco Bolson	63	57
Dept. of the Army – Fort Bliss	Hueco Bolson	0	100

Source: Texas Water Development Board – Data for 1997
*Municipal Water District

Table 4-11b. Public Water Supply Systems (Ground Water) in the Vicinity (2.5 – 25 miles) of the Longhorn Pipeline System

Public Water Supply System	Aquifer Used	% of Total Supply- Surface Water	% of Total Supply – Groundwater
Rutersville	Gulf Coast	0	100
Manchaca	Edwards (BFZ)	0	100
Dripping Springs	Trinity	0	100
Cherry Spring	Ellenburger-San Saba	0	100
London	Edwards-Trinity	0	100
Cleo	Edwards-Trinity	0	100
Willow City	Ellenburger-San Saba	0	100

Source: TWDB (1997) and LCRA (1999)

Table 4-12. Municipal Water Use by County and Aquifer Along the Longhorn Pipeline System Route

County	Aquifer System(s)	Municipal Use Ground Water Pumpage 1997 (acre-feet)	Public Supply Use % of Total Pumpage
Harris	Gulf Coast	336,878	90
Waller	Gulf Coast, Brazos River Alluvium	27,517	16
Austin	Gulf Coast, Brazos River Alluvium	11,409	28
Fayette	Carrizo-Wilcox, Sparta, Queen City, Gulf Coast, Colorado River Alluvium	3,328	86
Bastrop	Carrizo-Wilcox, Queen City, Sparta, Colorado River Alluvium	7,895	89
Travis	Trinity, Edwards (BFZ)	8,708	86
Hays	Trinity, Edwards (BFZ)	2,851	85
Blanco	Trinity, Ellenburger-San Saba, Marble Falls, Hickory	810	49
Gillespie	Edwards-Trinity, Ellenburger-San Saba, Trinity, Hickory, Marble Falls,	3,642	57
Llano	Ellenburger- San Saba, Trinity, Hickory, Marble Falls	156	7
Mason	Ellenburger-San Saba, Hickory, Marble Falls	818	8
Kimble	Edwards-Trinity	195	23
Menard	Edwards-Trinity	73	8
Sutton	Edwards-Trinity	1,417	38
Schleicher	Edwards-Trinity	566	20
Crockett	Edwards-Trinity	1,675	63
Reagan	Edwards- Trinity	637	1
Upton	Cenozoic Pecos Alluvium, Edwards-Trinity	19,432	4
Crane	Cenozoic Pecos Alluvium	1,088	37
Ector	Edwards-Trinity Cenozoic Pecos Alluvium	1,064	9
Ward	Cenozoic Pecos Alluvium, Dockum	9,077	57
Reeves	Edwards_Trinity, Cenozoic Pecos Alluvium, Rustler, Dockum	1,255	1
Culberson	Edwards-Trinity, Capitan Reef Complex, Rustler	22	14
Hudspeth	Hueco Bolson, Bone Spring, Capitan Reef	131,692	<1
El Paso	Hueco Bolson	86,161	90

Source: Texas Water Development Board, 1997

Table 4-13. Springflow Sites in the Vicinity of the Longhorn Pipeline System

County	Spring Name	Location (lat-long)	Aquifer
Hudspeth	Ojos del Alamo	N31 32 W105 43	Edwards-Trinity
	Apache Spring	N31 27 W104 58	Bone Spring Ls.
Schleicher	Government Springs	N30 50 W106 06	Edwards-Trinity
Kimble	Iona Spring	N 30 42 W99 41	Edwards-Trinity
	Gentry Spring	N30 39 W99 55	Edwards-Trinity
	Scott Spring	N30 37 W99 39	Edwards-Trinity
Mason	Anderegg Spring	N30 31 W99 08	Ellenburger-San Saba
Edwards-Trinity	Lange Springs	N30 28 W99 08	Edwards-Trinity
Blanco	Rocky Creek Spring	N30 15 W98 32	Ellenburger-San Saba
	Buffalo Spring	N30 20 W98 26	Ellenburger-San Saba
	Crofts Spring	N30 19 W98 23	Ellenburger-San Saba
	Hobbs Spring	N30 18 W98 25	Ellenburger-San Saba
Travis	Barton Springs	N30 16 W97 47	Edwards (BFZ)
Bastrop	Burleson Springs	N30 05 W97 21	Carrizo-Wilcox

Table 4-14. Estimated Hydrogeologic Sensitivity and Proximal Sensitivity (Sensitivity of Public Water Supply Receptors) in the Vicinity of the Longhorn Pipeline System Route

Starting Mileage	Ending Mileage	Hydrogeologic Unit	Hydrogeologic Sensitivity	Proximal Sensitivity	Total Sensitivity Sum A+B	Sensitivity and Justification
0	59.8	Gulf Coast Aquifer System	4	5	9	Not Sensitive – Deep Soil Formation with surface clays
59.8	66.0	Brazos River Alluvium	3	5	8	Sensitive – Unconsolidated Alluvium
66.0	80.9	Gulf Coast Aquifer System	5	5	10	Not Sensitive – Deep Soil Formation with surface clays
80.9	81.2	Brazos River Alluvium	3	5	8	Sensitive – Unconsolidated Alluvium
81.2	88.9	Gulf Coast Aquifer System	4	5	9	Not Sensitive – Deep Soil Formation with surface clays
88.9	91.0	Brazos River Alluvium	3	5	8	Sensitive – Unconsolidated Alluvium
91.0	98.6	Gulf Coast Aquifer System	4	5	9	Not Sensitive – Deep Soil Formation with surface clays
98.6	99.0	Colorado River Alluvium	3	5	8	Sensitive – Unconsolidated Alluvium
99.0	111.5	Gulf Coast Aquifer System	4	5	9	Not Sensitive – Deep Soil Formation with surface clays
111.5	112.5	Colorado River Alluvium	3	5	8	Sensitive – Unconsolidated Alluvium
112.5	118.6	No major or minor aquifer outcrops present	5	5	10	Low Sensitivity– Deep Clayey soil formation
118.6	119.7	Colorado River Alluvium	3	5	8	Sensitive – Unconsolidated Alluvium
119.7	122.1	No major or minor aquifer outcrops present	5	5	10	Low Sensitivity – Deep Clayey soil formation
122.1	123.1	Colorado River Alluvium	3	5	8	Sensitive - Unconsolidated Alluvium
123.1	125.6	No major or minor aquifer outcrops present	5	5	10	Low Sensitivity - Deep Clayey soil formation
125.6	127.5	Colorado River Alluvium	3	5	8	Sensitive – Unconsolidated Alluvium
127.5	128.9	No major or minor aquifer outcrops present	5	5	10	Low Sensitivity – Deep Clayey soil formation
128.9	141.5	Colorado River Alluvium	3	5	8	Sensitive – Unconsolidated Alluvium
141.5	142.2	Carrizo-Wilcox Aquifer outcrop	3	5	8	Low – Moderate Sensitivity – Deep Sandy Soil Formation
142.2	143.2	Colorado River Alluvium	3	5	8	Sensitive – Unconsolidated Alluvium

Table 4-14. (Continued)

Starting Mileage	Ending Mileage	Hydrogeologic Unit	Hydrogeologic Sensitivity	Proximal Sensitivity	Total Sensitivity Sum A+B	Sensitivity and Justification
143.2	150.7	Carrizo-Wilcox Aquifer outcrop	3	5	8	Low – Moderate Sensitivity – Deep sandy soil formation
150.7	157.4	No major or minor aquifer outcrops present	5	5	10	Not Sensitive - Deep clayey soil
157.4	157.7	Colorado River Alluvium	3	5	8	Sensitive - Unconsolidated Alluvium
157.7	163.6	No major or minor aquifer outcrops present	5	5	10	Not Sensitive – Deep Soil
163.6	164.9	Colorado River Alluvium	3	3	6	Onion Creek watershed - PWS wells downstream at confluence with Colorado River
164.9	170.5	None	5	5	10	Upper Confining unit of Edwards (BFZ) Aquifer
170.5	170.6	Edwards Aquifer (BFZ)	2	2	4	Sensitive – Karst area
170.6	171.2	Edwards Aquifer (BFZ) Leached and Collapsed Member	1	2	3	Hypersensitive –Karst High Permeability Unit
171.2	171.5	Edwards Aquifer (BFZ)	2	2	4	Sensitive – Karst area
171.5	171.7	Edwards Aquifer (BFZ) Leached and Collapsed Member	1	2	3	Hypersensitive-Karst High Permeability Unit
171.7	171.9	Edwards Aquifer (BFZ)	2	2	4	Sensitive – Karst area
171.9	172.3	Edwards Aquifer (BFZ)	2	2	4	Sensitive - Regional Dense member of Person formation - near by karst features
172.3	172.4	Edwards Aquifer (BFZ) Kirshberg Evaporite Member	1	1	2	Hypersensitive – Karst High Permeability Unit
172.4	172.7	Edwards Aquifer (BFZ)	2	2	4	Sensitive – Karst area
172.7	173.1	Edwards Aquifer (BFZ) Kirshberg Evaporite Member	1	1	2	Hypersensitive – Karst High Permeability Unit
173.1	173.5	Edwards Aquifer (BFZ)	2	2	4	Sensitive - Karst area – Dolomitic member of Kainer Formation
173.5	199.0	Trinity Aquifer	4	4	8	Alternating clay and marl
199.0	206.0	Ellenburger-San Saba Aquifer	2	5	7	Known karst area
206.0	207.5	Edwards – Trinity (Plateau) Aquifer	4	5	9	Alternating clay and marl
207.5	210.0	Ellenburger - San Saba Aquifer	2	5	7	Known karst area
210.0	214.5	Edwards - Trinity (Plateau Aquifer	4	5	9	Alternating clay and marl
214.5	215.3	Ellen burger - San Saba Aquifer	2	5	7	Sensitive Karst

Table 4-14. (Continued)

Starting Mileage	Ending Mileage	Hydrogeologic Unit	Hydrogeologic Sensitivity	Proximal Sensitivity	Total Sensitivity Sum A+B	Sensitivity and Justification
215.3	224.8	Edwards-Trinity (Plateau) Aquifer	4	5	9	Alternating clay and marl
224.8	226.2	Ellenburger-San Saba Aquifer	2	5	7	Sensitive - Karst
226.2	244.9	Edwards – Trinity (Plateau) Aquifer	4	5	9	Alternating clay and marl
244.9	276.6	Ellenburger-San Saba Aquifer	2	5	7	Sensitive - Karst
276.6	281.2	Edwards – Trinity (Plateau) Aquifer	3	5	8	Low - Moderate Permeability Sandstone
281.2	341.0	Edwards-Trinity (Plateau) Aquifer	3	4	7	Known karst area
341.0	346.0	Edwards-Trinity Aquifer	2	1	3	City of Eldorado PWS wells < 2.5 mi north; and known karst features <2.5 miles north
346.0	356.0	Edwards-Trinity Aquifer	3	3	6	High permeability limestone
356.0	361.0	Edwards-Trinity Aquifer	3	2	5	PWS well 2.5 miles north
361.0	410.0	Edwards-Trinity Aquifer	3	4	7	Known karst area
410.0	423.0	Edwards-Trinity Aquifer	3	3	6	City of Big Lake PWS wells within 25 miles along stream in karst area and known karst feature within 2.5 miles of pipeline; Upton County Water District Wells within 2.5 miles south of pipeline
423	428	Edwards-Trinity Aquifer	2	2	4	
428.0	446.8	Edwards - Trinity (Plateau) Aquifer	3	3	6	Limestones and Sandstones-Moderate permeability
446.8	492.0	Cenozoic Pecos Alluvium	3	4	7	Unconsolidated Alluvium
492.0	495.0	Cenozoic Pecos Alluvium	5	2	7	City of Grand Falls PWS wells within 2.5 miles south
495.0	508.7	Cenozoic Pecos Alluvium	3	4	7	Unconsolidated Alluvium
508.7	516.7	None	5	5	10	No aquifers present
516.7	565.5	Cenozoic Pecos Alluvium & Edwards Trinity (Plateau) Aquifer	3	4	7	Unconsolidated alluvium and sandstone
565.5	570.6	Rustler Aquifer Outcrop	4	5	9	Low Permeability limestones No PWS wells in proximity
570.6	687.5	No major or minor aquifers present	4	5	9	No PWS wells in close proximity
687.5	694.6	Hueco Bolson Aquifer	5	2	7	28 PWS wells within 2.5 miles
*0.00	25.80	Cenozoic Pecos Alluvium	3	5	8	Unconsolidated Alluvium
*25.80	28.00	Edwards-Trinity (Plateau) Aquifer	3	5	8	Non-karst area

*Odessa Lateral

Table 4-15. Summary of Ground Water Sensitivity, Re-route

Starting Mileage	Ending Mileage	Major or Minor Aquifer System	Hydrogeologic Unit	Physical Sensitivity (hydrogeology) (A)	Proximal Sensitivity (receptors) (B)	Total Sensitivity (A) + (B)	Remarks
0.00	4.50	None	Edwards Aquifer Upper Confining Unit	5	5	10	
4.50	12.12	None	Edwards Aquifer Upper Confining Unit	5	3	8	Public Water Supply Wells within 2.5 miles
12.12	12.25	Edwards (BFZ)	Georgetown Formation	3	2	5	Karst Features and Public Water Supply Wells within 2.5 miles
12.25	12.61	None	Edwards Aquifer Upper Confining Unit	5	2	7	Karst Features and Public Water Supply Wells within 2.5 miles
12.61	13.24	Edwards (BFZ)	Person Formation - Leeched and Collapsed Member (undivided)	1	2	3	Karst Features and Public Water Supply Wells within 2.5 miles
13.24	13.72	Edwards (BFZ)	Georgetown Formation	3	2	5	Karst Features and Public Water Supply Wells within 2.5 miles
13.72	13.79	None	Edwards Aquifer Upper Confining Unit	5	2	7	Karst Features and Public Water Supply Wells within 2.5 miles
13.79	13.80	Edwards (BFZ)	Georgetown Formation	3	2	5	Karst Features and Public Water Supply Wells within 2.5 miles
13.80	13.98	None	Edwards Aquifer Upper Confining Unit	5	2	7	Karst Features and Public Water Supply Wells within 2.5 miles
13.98	13.99	Edwards (BFZ)	Kainer Formation - Grainstone Member	2	2	4	Karst Features and Public Water Supply Wells within 2.5 miles
13.99	14.20	Edwards (BFZ)	Kainer Formation - Kirshberg Evaporite Member	1	2	3	Karst Features and Public Water Supply Wells within 2.5 miles
14.20	14.29	Edwards (BFZ)	Kainer Formation - Grainstone Member	2	2	4	Karst Features and Public Water Supply Wells within 2.5 miles
14.29	14.54	Edwards (BFZ)	Kainer Formation - Kirshberg Evaporite Member	1	2	3	Karst Features and Public Water Supply Wells within 2.5 miles
14.54	14.62	Edwards (BFZ)	Person Formation - Cyclic and Marine Members (undivided)	2	2	4	Karst Features and Public Water Supply Wells within 2.5 miles

Table 4-15. (Continued)

Starting Mileage	Ending Mileage	Major or Minor Aquifer System	Hydrogeologic Unit	Physical Sensitivity (hydrogeology) (A)	Proximal Sensitivity (receptors) (B)	Total Sensitivity (A) + (B)	Remarks
14.62	15.14	Edwards (BFZ)	Kainer Formation - Basal Nodular Member	3	2	5	Karst Features and Public Water Supply Wells within 2.5 miles
15.14	15.63	Edwards (BFZ)	Kainer Formation - Dolomitic Member	2	2	4	Karst Features and Public Water Supply Wells within 2.5 miles
15.63	15.70	Edwards (BFZ)	Kainer Formation - Basal Nodular Member	3	2	5	Karst Features and Public Water Supply Wells within 2.5 miles
15.70	16.25	Edwards (BFZ)	Kainer Formation - Dolomitic Member	2	2	4	Karst Features and Public Water Supply Wells within 2.5 miles
16.25	16.59	Edwards (BFZ)	Kainer Formation - Basal Nodular Member	3	2	5	Karst Features and Public Water Supply Wells within 2.5 miles
16.59	17.38	Edwards (BFZ)	Kainer Formation - Dolomitic Member	2	2	4	Karst Features and Public Water Supply Wells within 2.5 miles
17.38	17.57	Edwards (BFZ)	Kainer Formation - Basal Nodular Member	3	2	5	Karst Features and Public Water Supply Wells within 2.5 miles
17.57	17.76	Trinity	Glen Rose - Formation - Upper Member; Edwards Aquifer Lower Confining Unit	4	2	6	Karst Features and Public Water Supply Wells within 2.5 miles
17.76	17.85	Edwards (BFZ)	Kainer Formation - Basal Nodular Member	3	2	5	Karst Features and Public Water Supply Wells within 2.5 miles
17.85	17.96	Edwards (BFZ)	Kainer Formation - Dolomitic Member	2	2	4	Karst Features and Public Water Supply Wells within 2.5 miles
17.96	18.04	Edwards (BFZ)	Kainer Formation - Basal Nodular Member	3	2	5	Karst Features and Public Water Supply Wells within 2.5 miles
18.04	18.56	Edwards (BFZ)	Kainer Formation - Dolomitic Member	2	2	4	Karst Features and Public Water Supply Wells within 2.5 miles
18.56	18.60	Edwards (BFZ)	Kainer Formation - Basal Nodular Member	3	2	5	Karst Features and Public Water Supply Wells within 2.5 miles
18.60	21.01	Edwards (BFZ)	Kainer Formation - Dolomitic Member	2	2	4	Karst Features and Public Water Supply Wells within 2.5 miles

Table 4-15. (Continued)

Starting Mileage	Ending Mileage	Major or Minor Aquifer System	Hydrogeologic Unit	Physical Sensitivity (hydrogeology) (A)	Proximal Sensitivity (receptors) (B)	Total Sensitivity (A) + (B)	Remarks
21.01	21.02	Edwards (BFZ)	Kainer Formation - Basal Nodular Member	3	2	5	Karst Features and Public Water Supply Wells within 2.5 miles
21.02	21.12	Edwards (BFZ)	Kainer Formation - Dolomitic Member; Terminus of Austin Re-route	2	2	4	Karst Features and Public Water Supply Wells within 2.5 miles

Table 4-16. Summary of Data from Selected USGS Flow Gauges

Map ID	Station	Station Name	Start Year	End Year	Basin Area (sq miles)	Monthly Mean Flows (cfs)				Mean Annual Flow (cfs)	Extreme Flow (cfs)	Flowrate Exceeded % of Time		
						Jan	April	July	Oct			10%	50%	90%
3	08111700	Mill Creek near Bellville, Tx	1940	1993	376	280	329	34	114	237	44,400	280	34	4
15	08152900	Pedernales River near Fredericksburg, Tx	1980	1995	369	43	49	45	69	62	64,000	90	22	3
11	08153500	Pedernales River near Johnson City, Tx	1940	Current	901	128	244	103	228	197	441,000	284	50	4.8
7	08155200	Barton Creek at Hwy 71 near Oak Hill, Tx	1980	Current	89.7	44.6	50.9	12.8	12.8	46.7	14,900	88	4.2	0.02
5	08158000	Colorado River at Austin, Tx	1869	Current	39,009	1,240	2,701	2,769	2,018	2270	481,000	3,960	1,130	175
9	08158700	Onion Creek near Driftwood, Tx	1980	Current	124	54	53.1	27.7	19.4	53.1	11,000	120	9	0.36
8	08158810	Bear Creek below FM Road 1826 near Driftwood, Tx	1980	Current	12.2	6.02	6.37	2.45	2.56	6.21	10,200	13	1.2	0
6	08158840	Slaughter Creek at FM Road 1826 near Austin, Tx	1980	Current	8.24	5.12	4.71	1.24	3.31	5.72	6,330	10	0.34	0
4	08161000	Colorado River at Columbus, Tx	1869	Current	41,640	2,398	3,567	3,332	2,941	3151	190,000	6,000	1630	397
16	08150800	Beaver Creek near Mason, Tx	1964	Current	215	13.6	20	4.02	32.2	91.5	66,900	23	3.1	0.2
12	08151500	Llano River at Llano, Tx	1935	Current	4,197	285	384	233	538	380	260,000	545	155	40
18	08144500	San Saba River at Menard, Tx	1899	1995	1,135	32	70	106	91	63	130,000	60	23	2
19	08434000	Toyah Cr Bl Toyah Lk near Pecos, (Disc)	1940	1951	3,709	2	1	19	21	7	64,000	2	0	0
2	08068720	Cypress Cr at Katy-Hockley Road near Hockley, Tx	1960	Current	110	103	67.3	18.1	41	59.3	2,370	115	2.9	0
1	08068740	Cypress Creek at House-Hahl Road near Cypress, Tx	1937	Current	131	126	90.4	27.1	49.7	78.4	5,200	161	5.3	0.3
	08111500	Brazos River near Hempstead, Tx	1939	1996	43,880	6,883	8,640	4,811	4,594	6,813	143,000	17,600	2,490	688
	08114000	Brazos River near Richmond, Tx	1941	1996	45,007	7,907	9,153	4,932	5,077	7,500	119,000	18,800	2,880	775
	08190500	West Nueces River near Brackettville, Tx	1939	Current	694	2.45	9.95	48	83.4	35.3	246,000	8.3	0.01	0
	08194200	San Casimiro Creek near Freer, Tx	1962	Current	469	2.18	19.8	16.4	130	49.3	82,000	17	0	0
	08412500	Pecos River near Orla, Tx	1938	Current	21,210	39.3	198	239	157	145	23,700	365	34	5.3
	08446500	Pecos River near Girvin, Tx	1939	Current	29,560	65.7	36.9	48	204	74.1	20,000	86	30	11

Table 4-17. Summary of Pipeline Stream Crossings and Upstream Watersheds

Stream at Crossing	Map ID	Pipeline Station for Crossing (mi)	Slope of Channel at Crossing	Basin Area (sq mi)	Stream Order	2-Year Flood, Conservative Estimate (cfs)	100-Year Flood, Conservative Estimate (cfs)	Relative Scour Risk	
								2- year	100- year
Hunting Bayou	1	0.1	0.0006	14.4	urban	urban	Urban	urban	urban
Greens Bayou	3	3.2	0.0000	182	urban	urban	Urban	urban	urban
Halls Bayou	8	13.2	0.0009	24.7	urban	urban	Urban	urban	urban
Cypress Creek	34	47.1	0.0009	89.9	3	2,701	17,689	1.08	1.03
Unnamed Tributary to Crypress Creek	36	48.7	0.0010	3.9	2	311	1,568	0.87	0.85
Mound Creek	37	50.4	0.0013	43.0	2	1,211	8,571	1.00	0.97
Live Oak	38	53.9	0.0017	10.1	2	782	4,381	0.95	0.92
Harris Creek Tributary	41	58.7	0.0033	7.5	2	576	3,941	0.93	0.91
Harris Creek Tributary	42	59.7	0.0020	8.0		596	2,812	0.93	0.89
Clear Creek[1]	44	62.6	0.0010	74.3	3	2,245	13,247	1.06	1.01
Brazos River	45	64.0	0.00033	44,000	Major	57,800	138,000	Requires detailed analysis	
Muddy Branch	48	69.2	0.0022	9.2	2	1,172	5,293	0.99	0.93
East Fork Mill Creek	57	81.2	0.0007	126.0	3	3,539	45,282	1.11	1.11
Dogwood Creek	60	89.2	0.0025	11.1	2	988	8,526	0.98	0.97
West Fork Mill Creek	61	90.8	0.0013	44.0	3	2,034	21,479	1.05	1.04
Jacks Creek	67	98.3	0.0030	11.8	2	1,019	8,548	0.98	0.97
Cummins Creek	68	99.2	0.0018	94.3	3	4,155	28,229	1.12	1.07
Rabbs Creek	74	112.3	0.0013	81.3	3	4,366	36,109	1.13	1.09
Knobbs Creek	77	118.8	0.0033	23.2	2	1,453	16,106	1.01	1.02
Dreissner Branch	78	119.9	0.0033	6.8	2	761	5,178	0.95	0.93
Pin Oak Creek	80	122.5	0.0014	50.1	3	3,668	29,073	1.11	1.07
Gravelly Creek	81	123.0	0.0025	18.7	2	1,297	10,825	1.00	0.99
JD Creek	82	126.7	0.0050	6.7	2	755	8,909	0.95	0.97
Alum Creek	86	131.5	0.0028	46.1	3	3,884	36,491	1.12	1.09
Little Alum Creek	87	132.3	0.0056	4.6	2	622	7,321	0.93	0.96
Colorado River	89	134.5	0.00013	39,800	Major	48,300	192,000	Requires detailed analysis	
Cedar Creek[2]	93	142.8	0.0014	90	3	4,079	36,043	1.12	1.09
Unnamed	92	142.9	0.0048	7.3	2	691	8,167	0.94	0.97
Maha Creek[3]	97	151.7	0.0029	32.7	2	2,677	14,719	1.08	1.01
Dry Creek	99	157.4	0.0029	22.2	2	1,312	18,233	1.00	1.03
Cottonmouth Creek	100	162.3	0.0040	2.2	1	324	1,910	0.87	0.86
Marble Creek	101	163.5	0.0143	3.8	1	449	3,329	0.90	0.90
Onion Creek	103	164.0	0.0014	284.4	Large	6,983	67,042	1.18	1.14
Barton Creek	109	180.9	0.0050	40.9	2	2,392	42,053	Not applicable: rocky outcrop of limestone and granite in Balcones Fault Zone and Hill Country physiographic provinces	
Flat Creek	112	193.2	0.0091	31.0	3	1,919	29,915		
Pedernales River	115	198.8	0.0026	1,000.0	Large	15,488	210,574		
Cottonwood Creek	119	203.2	0.0111	10.3	2	901	9,851		
Hickory Creek	125	209.9	0.0063	12.2	2	1,024	12,605		
White Oak Creek	127	213.3	0.0100	7.5	2	829	15,398		
Crabapple Creek	135	229.3	0.0100	63.4	3	2,876	52,047		
Bernst Creek	140	237.8	0.0100	3.8	2	543	10,371		
Cherry Spring Creek	142	241.7	0.0040	11.0	2	1,011	15,643		
Marshall Creek	143	242.7	0.0059	10.9	2	947	11,115		
Squaw Creek	150	248.5	0.0063	39.6	2	2,231	56,941		
Threadgill Creek	151	250.0	0.0042	117.3	4	4,363	94,579		
James River	161	263.9	0.0029	322.1	Large	8,030	133,987		
Mill Creek	164	267.9	0.0067	7.3	2	786	12,240		
Rocky Creek	166	273.7	0.0100	10.5	2	993	16,326		
Llano River	168	276.5	0.00115	2,400	Major	18,200	299,000		
Terret Draw	185	315.9	0.0028	34.6	3	1,711	11,473	Not applicable: rocky outcrop of limestone on Edwards Plateau physiographic province	
Middle Valley	192	324.2	0.0011	137.2	3	3,545	13,363		
Antelope Draw	197	334.3	0.0018	62.0	3	2273	10,660		

Table 4-17. (Continued)

Stream at Crossing	Map ID	Pipeline Station for Crossing (mi)	Slope of Channel at Crossing	Basin Area (sq mi)	Stream Order	2-Year Flood, Conservative Estimate (cfs)	100-Year Flood, Conservative Estimate (cfs)	Relative Scour Risk	
								2- year	100- year
Big Lake Draw	211	402.6	0.0030	46.0	2	627	12,286	0.93	1.00
Unnamed	216	415.8	0.0022	24.5	2	499	10,934	0.91	0.99
China Draw	224	433.1	0.0026	17.1	2	374	8,757	0.89	0.97
Mayfield Draw	234	450.2	0.0025	76.3	3	508	7,294	0.91	0.96
Landreth Draw	239	458.3	0.0033	247.0		1,348	32,665	1.01	1.08
Pecos River	250	525.6	0.0006	25,975	Major	NA	NA	Requires detailed analysis	
Cottonwood Creek	254	556.6	0.0038	341.9	3	1,939	18,521	1.04	1.03
Cottonwood Creek	256	565.3	0.0071	247.5	3	1,348	12,645	1.01	1.00
Cottonwood Creek	257	577.3	0.0077	63.4	2	877	6,246	Not applicable: rocky outcrops of limestone on E. slope, Delaware Mtns	
Frijole Draw	258	585.9	0.0143	7.8	2	291	1,717	0.86	0.85
Burro Canyon	263	597.7	0.0091	8.8	2	104	635	Not applicable: rocky outcrops of limestone on E. slope, Delaware Mtns	
Cox Canyon	265	601.1	0.0100	21.2	2	234	1,142		
Unnamed	269	625.1	0.0100	16.2	2	1,989	16,023	Not applicable: rocky outcrops of limestone in Sierra Diablo Mtns	
Antelope Gulch	274	631.0	0.0043	797.8	Large	2,700	33,772		
Antelope Draw	282	651.3	0.0080	48.4	2	543	6,787	Not applicable: rocky outcrops of limestone in Hudspeth Cty	
Wildhorse	283	669.6	0.0091	83.3	2	695	7,861	Not applicable: rocky outcrops of limestone in Hueco Mtns	
Middle Canyon	286	680.8	0.0032	9.5	2	426	2,607	0.90	0.88
Fourmile Draw	287	684.0	0.0063	37.4	2	884	6,993	0.97	0.96
Pow Wow Canyon	288	686.6	0.0133	46.2	2	347	3,474	0.88	0.90
*Landreth Draw	1	1.5	241.9	3	1,238	30,114	4	Medium 2-year flood	
*Landreth Draw	2	7.0	65.1	1	1,587	29,029	4	Medium 2-year flood	2-year flood higher than #1 due to high watershed shape factor

[1]Clear Creek does not cross the pipeline, but at one location parallels the pipeline at a distance of 85 miles.
[2]Cedar Creek does not cross the pipeline, but at one location parallels the pipeline at a distance of 320 miles.
[3]Maha Creek does not cross the pipeline, but at one location parallels the pipeline at a distance of 180 miles.

Sources:
Risk reference: Pemberton and Lara, 1984.
Sources for 2-year floods: Asquith and Slade, 1997; Asquith, 1998; Asquith et al., 1996; Rines, 1998.

*Odessa Lateral

Table 4-18. Summary of Chemical Analyses on Surface Water Samples from Study Area Streams (per STORET)

Map ID	STORET Station	Station Name	Mean Analytical Results / # Of Samples Analyzed								
			Arsenic (µg/L)	Chloride, Total in Water (mg/L)	Fluoride, (mg/L)	Iron (µg/L)	Nitrite Plus Nitrate (mg/L as N)	Oxygen, (mg/L)	Phos-Phorus, Total (mg/ L as P)	Sulfate, Total (Mg/L)	Fecal Coliform, MF,M-FC, 0.7 µm (cols/100 mL)
			Standard								
			50	250	4.0	300	10	5 or 6 for exceptional	0.01 to 0.3	250	400
			Type of Standard								
			Primary	Secondary	Primary	Secondary	Primary	Aquatic		Secondary	Recreation
4	8075770	Hunting Bayou at I-610, Houston, Tx	6.0/ 26	52.7/ 30	0.59/ 30	27.6/ 25	3.9/ 13	6.8/ 33	1.12/ 26	49.9/ 29	2,611/ 33
5	8076000	Greens Bayou near Houston, Tx	6.2/ 30	72.1/ 29	0.30/ 29	26.7/ 29	3.7/ 13	6.9/ 36	2.28/ 25	32.6/ 27	2,336/ 37
7	11332	Cypress Creek at Grant Rd Near Cypress		32.7/ 51				7.2/ 49	1.24/ 51	13.0/ 53	
9	11848	Brazos River at FM 1093		118.0/ 13				9.0/ 15	0.00/ 14	90.0/ 11	
10	11578	Clear Creek at FM 1887 Northwest of Monaville		48.8/ 6				7.5/ 5	0.00/ 6	15.0/ 4	
12	11576	Mill Creek at Hwy 36	5.0/ 4	44.8/ 13	0.00/ 5	53.8/ 4		8.1/ 9	0.00/ 8	15.3/ 12	
13	11574	Mill Creek at County Road 2.8 Miles Southwest of Bellville		48.7/ 6				7.1/ 26	0.00/ 6	13.5/ 6	
15	12290	Colorado River at Old Hwy 71	1.8/ 5	50.5/ 87	0.33/ 53	12.6/ 5	0.9/ 5	8.0/ 109	0.37/ 92	46.0/ 84	2,430/ 6
16	12249	Cummins Creek at FM 109 north of Columbus	3.5/ 13	66.3/ 46		80.3/ 4		7.8/ 67	0.00/ 47	11.4/ 44	
17	12292	Colorado River at Hwy 71 at La Grange		51.6/ 16				7.8/ 29	0.00/ 14	40.1/ 16	
18	12457	Colorado River at Hwy95/Hwy Loop 230 at Smithville		58.0/ 29				8.4/ 30	0.31/ 29	51.6/ 29	
20	8159200	Colorado River at Bastrop, Tx		63.0/ 52	0.35/ 54		2.1/ 10	8.2/ 54	0.45/ 44	53.7/ 53	
21	12466	Colorado River at County Park		64.2/ 53				8.7/ 54	0.53/ 55	56.5/ 55	
22	8158650	Colorado River below Austin, Tx	1.0/ 32	60.9/ 55	0.34/ 57	6.3/ 34	2.2/ 16	9.1/ 56	0.38/ 41	48.5/ 55	252/ 54
23	12435	Onion Creek upstream from FM 973		29.7/ 37				7.8/ 51	0.14/ 35	48.6/ 38	
25	8158000	Colorado River at Austin, Tx	1.0/ 25	60.6/ 36	0.23/ 37	6.2/ 31	0.3/ 34	9.0/ 33	0.02/ 34	45.8/ 34	166/ 34
26	8155505	Barton Creek below Barton Springs, Austin, Tx	1.0/ 1	13.0/ 1	0.10/ 1	16.0/ 1	0.6/ 11	8.5/ 1	0.15/ 11	25.0/ 1	11,758/ 10
27	8155500	Barton Springs at Austin, Tx	1.0/ 43	26.9/ 46	0.22/ 45	4.1/ 41	1.3/ 32	6.5/ 55	0.02/ 59	29.8/ 46	184/ 56
29	8155300	Barton Creek at Loop 360, Austin, Tx	1.0/ 27	13.5/ 31	0.16/ 32	10.2/ 27	0.2/ 66	8.9/ 25	0.10/ 112	22.8/ 30	12,268/ 99
30	12448	Onion Creek 0.7 mile north of Buda next to Mopac		22.3/ 62				9.3/ 60	0.00/ 62	30.8/ 57	

Table 4-18. (Continued)

Map ID	STORET Station	Station Name	Mean Analytical Results / # Of Samples Analyzed								
			Arsenic (µg/L)	Chloride, Total in Water (mg/L)	Fluoride (mg/L)	Iron (µg/L)	Nitrite Plus Nitrate (mg/L as N)	Oxygen (mg/L)	Phos-Phorus, Total (mg/ L as P)	Sulfate, Total (Mg/L)	Fecal Coliform, MF,M-FC, 0.7 µm (cols/100 mL)
			Standard								
			50	250	4.0	300	10	5 or 6 for exceptional	0.01 to 0.3	250	400
			Type of Standard								
			Primary	Secondary	Primary	Secondary	Primary	Aquatic		Secondary	Recreation
31	8155240	Barton Creek at Lost Creek Blvd. near Austin, Tx	1.0/ 23	28.6/ 25	0.19/ 24	5.9/ 22	0.2/ 94	8.1/ 34	0.08/ 110	52.3/ 24	5,236/ 102
32	8155220	Barton Creek at Barton Creek Blvd., Austin, Tx	1.0/ 5	35.8/ 5	0.30/ 5	7.4/ 5	0.1/ 8	7.5/ 9	0.01/ 9	44.2/ 5	25/ 8
34	8154510	Colorado River below Mansfield Dam, Austin, Tx		80.3/ 39	0.23/ 37			6.4/ 40	0.00/ 40	59.2/ 39	
35	8155200	Barton Creek at Hwy 71 near Oak Hill, Tx	1.0/ 26	17.1/ 27	0.20/ 22	4.2/ 23	0.1/ 124	8.1/ 42	0.05/ 124	26.4/ 25	5,898/ 114
36	8158700	Onion Creek near Driftwood, Tx	1.0/ 36	14.2/ 38	0.19/ 40	5.1/ 34	0.2/ 24	8.6/ 47	0.02/ 51	31.8/ 38	1,171/ 60
36	8158700	Onion Creek near Driftwood, Tx	1.0/ 36	14.2/ 38	0.19/ 40	5.1/ 34	0.2/ 24	8.6/ 47	0.02/ 51	31.8/ 38	1,171/ 60
37	12451	Onion Creek at FM 150	1.0/ 29	13.9/ 34	0.19/ 33	5.1/ 28	0.1/ 6	8.6/ 87	0.02/ 41	30.8/ 33	589/ 45
38	12369	Pedernales River at Cr 962 at Hammett's Crossing		40.5/ 11				8.0/ 32	0.00/ 11	24.9/ 10	
39	12260	Flat Creek at Blanco Cr 201		11.5/ 2				7.0/ 8	0.00/ 2	31.0/ 2	
46	12383	Llano River County Road 6.5 Miles upstream from Lake LBJ		20.7/ 30				9.2/ 48	0.00/ 31	16.3/ 30	
47	12265	North Grape Creek at FM 1320		44.0/ 2				7.8/ 8	0.00/ 2	20.5/ 2	
48	12386	Llano River 0.4 mile downstream from bridge on State Hwy 16.	2.2/ 6	20.1/ 9	0.26/ 7	6.5/ 6	0.1/ 6	8.9/ 8	0.01/ 9	15.7/ 9	63/ 6
49	8151500	Llano River at Llano, Tx	2.2/ 6	21.3/ 7	0.26/ 7	6.5/ 6	0.1/ 6	8.9/ 7	0.02/ 7	15.4/ 7	63/ 6
50	12377	Pedernales River Goehman Lane		66.8/ 12				8.7/ 20	0.00/ 12	29.5/ 10	
51	12380	Pedernales River US 290 SE of Fredericksburg		59.8/ 26	0.00/ 14			9.8/ 32	0.00/ 26	32.5/ 26	
53	12208	James River on private Ranch Road 1.2 miles upstream		30.0/ 1				7.9/ 28	0.00/ 1	20.0/ 1	
54	12210	James River at upper Mason County Road Crossing		28.0/ 1				8.8/ 4	0.00/ 1	20.0/ 1	
55	14231	Llano River at Yates Crossing		14.0/ 8				8.0/ 7	0.00/ 8	7.4/ 8	
56	12389	Llano River at County Road 9.5 mi. northeast of Junction		14.4/ 30				8.4/ 28	0.00/ 30	12.0/ 28	

Table 4-18. (Continued)

Map ID	STORET Station	Station Name	Mean Analytical Results / # Of Samples Analyzed								
			Arsenic (µg/L)	Chloride, Total in Water (mg/L)	Fluoride (mg/L)	Iron (µg/L)	Nitrite Plus Nitrate (mg/L as N)	Oxygen (mg/L)	Phos-Phorus, Total (mg/ L as P)	Sulfate, Total (Mg/L)	Fecal Coliform, MF,M-FC, 0.7 µm (cols/100 mL)
			Standard								
			50	250	4.0	300	10	5 or 6 for exceptional	0.01 to 0.3	250	400
			Type of Standard								
			Primary	Secondary	Primary	Secondary	Primary	Aquatic		Secondary	Recreation
58	13257	Pecos River at Us 67		5,150.1/ 35	1.81/ 15			8.6/ 40	0.00/ 36	3,114.6/ 34	
59	13122	Diamond Y Draw @ 10 M upstream from Oil Field Rd		1,420.6/ 14	2.39/ 1			7.3/ 14	0.00/ 15	2260.6/ 14	
60	13260	Pecos River at FM 1776		4,550.2/ 21	1.55/ 14			8.9/ 26	0.00/ 22	2655.1/ 21	
62	8412500	Pecos River near Orla, Tx		2,968.1/ 47	0.88/ 44					2021.3/ 47	
63	13265	Pecos River at FM 652		2,976.5/ 78	0.92/ 60			8.6/ 34	0.00/ 33	2067.4/ 78	
64	13232	Rio Grande at Neely Canyon		593.2/ 39				8.6/ 29	0.95/ 39	512.1/ 39	
65	13234	Rio Grande at Zaragosa Bridge						7.7/ 67			

Table 4-19. Summary of Federal Clean Water Section 303(d) Stream Segments in Vicinity of Pipeline

Segment Number	Segment Name	Overall Priority	Summary of Impairment
1009	Cypress Creek	Medium/ Study Underway	Bacteria levels sometimes exceed the criterion established to assure the safety of contact recreation (L/NS). Average total dissolved solids values exceeded the segment criterion to protect aquatic life, water supply, and other water quality uses (M/CN). A TMDL for dissolved oxygen is underway for this water body.
1014	Buffalo Bayou above Tidal	Low	Bacteria levels sometimes exceed the criterion established to assure the safety of contact recreation (L/NS).
1017	Whiteoak Bayou above Tidal	Medium	Bacteria levels sometimes exceed the criterion established to assure the safety of contact recreation (L/NS). Mean lead in water concentration exceeded the criterion established to protect aquatic life from chronic exposure (M/NS).
1427	Onion Creek	Low	In the 25-mile portion below Dripping Springs, bacteria levels sometimes exceed the criterion established to assure the safety of contact recreation (M/NS). In the lower 10 miles below McKinney Falls, dissolved oxygen concentrations are occasionally lower than the standard established to assure optimum conditions for aquatic life (M/PS). Average concentrations of sulfate and total dissolved solids exceed the criterion established to safeguard general water quality uses (L/CN).
1428	Colorado River below Town Lake	Medium	In the upper 6 miles of the segment (below Austin), bacteria levels sometimes exceed the criterion established to assure the safety of contact recreation (L/NS).
1429	Town Lake	Medium	The fish consumption use is partially supported, based on a restricted-consumption advisory issued by the Texas Department of Health due to chlordane (M/PS).
1430	Barton Creek	Medium	Bacteria levels sometimes exceed the criterion established to assure the safety of contact recreation (M/NS).
2307	Rio Grande below Riverside Diversion	Low	Average chloride, sulfate, and total dissolved solids concentrations exceed the criteria established to safeguard general water quality issues.

Table 4-20. Distances from Stream Crossings to Downstream Water Rights

		Municipal				Irrigation				Industrial				Mining				Distance to Downstream Lake Mainstream (mi)	Lake Name
		Rights (ac-ft/no. of rights) Within:				Rights (ac-ft/no. of rights) Within:				Rights (ac-ft/no. of rights) Within:				Rights (ac-ft/no. of rights) Within:					
	Crossing No.	5 mi	20 mi	40 mi	60 mi	5 mi	20 mi	40 mi	60 mi	5 mi	20 mi	40 mi	60 mi	5 mi	20 mi	40 mi	60 mi		
Cypress Creek	34						3,041/ 2	3,041/ 2	3,041/ 2										
Unnamed Trib. to Crypress Creek	36						3,041/ 2	3,041/ 2	3,041/ 2										
Mound Creek	37						3,041/ 2	3,041/ 2	3,041/ 2										
Live Oak	38						3,041/ 2	3,041/ 2	3,041/ 2										
Harris Creek Trib.	41				75,000/ 1														
Harris Creek Trib.	42				75,000/ 1														
Clear Creek	44					136/ 1	136/ 1	136/ 1	136/ 1			10/ 1	10/ 1						
Brazos River	45					136/ 1	136/ 1	136/ 1	136/ 1			10/ 1	10/ 1						
Muddy Branch	48				75,000/ 1						10/ 1	10/ 1	10/ 1						
East Fork Mill Creek	57											10/ 1	10/ 1						
Dogwood Creek	60											10/ 1	10/ 1						
West Fork Mill Creek	61											10/ 1	10/ 1						
Jacks Creek	67							73/ 1	73/ 1										
Cummins Creek	68							73/ 1	73/ 1										
Rabbs Creek	74					33/ 2	33/ 2	148/ 6	148/ 6										
Knobbs Creek	77						35/ 1	150/ 5	150/ 5										
Dreissner Branch	78						35/ 1	150/ 5	150/ 5										
Pin Oak Creek	80						35/ 1	150/ 5	150/ 5										
Gravelly Creek	81						35/ 1	150/ 5	150/ 5										
JD Creek	82						35/ 1	35/ 1	150/ 5										
Alum Creek	86							35/ 1	150/ 5										
Little Alum Creek	87							35/ 1	150/ 5										
Colorado River	89							35/ 1	35/ 1										
Unnamed	92							35/ 1	35/ 1										
Cedar Creek	93							35/ 1	35/ 1										
Maha Creek	97								35/ 1										
Dry Creek	99																		
Cottonmouth Creek	100						67/ 1	67/ 1	67/ 1										

Table 4-20. (Continued)

		Municipal				Irrigation				Industrial				Mining				Distance to Downstream Lake Mainstream (mi)	Lake Name
		Rights (ac-ft/no. of rights) Within:				Rights (ac-ft/no. of rights) Within:				Rights (ac-ft/no. of rights) Within:				Rights (ac-ft/no. of rights) Within:					
	Crossing No.	5 mi	20 mi	40 mi	60 mi	5 mi	20 mi	40 mi	60 mi	5 mi	20 mi	40 mi	60 mi	5 mi	20 mi	40 mi	60 mi		
Marble Creek	101						67/ 1	67/ 1	67/ 1										
Onion Creek	103						67/ 1	67/ 1	67/ 1										
Barton Creek	109							40/ 1	40/ 1									32.9	Town Lake
Flat Creek	112						34/ 1	34/ 1	34/ 1									26.8	Lake Travis
Pedernales River	115	30/ 1	30/ 1	30/ 1	30/ 1		34/ 1	34/ 1	34/ 1									33.2	Lake Travis
Cottonwood Creek	119		30/ 1	30/ 1	30/ 1		34/ 1	34/ 1	34/ 1									41.1	Lake Travis
Hickory Creek	125			30/ 1	30/ 1			34/ 1	34/ 1									53.7	Lake Travis
White Oak Creek	127			30/ 1	30/ 1			34/ 1	34/ 1									59.9	Lake Travis
Crabapple Creek	135						1/ 1	1/ 1	1/ 1		4/ 1	4/ 1	4/ 1					33.3	Lake LBJ
Bernst Creek	140			1,200/ 1	1,200/ 1	46/ 1	46/ 1	187/ 5	247/ 6									51.3	Lake LBJ
Cherry Spring Creek	142			1,200/ 1	1,200/ 1	46/ 1	46/ 1	187/ 5	247/ 6									50.2	Lake LBJ
Marshall Creek	143			1,200/ 1	1,200/ 1	46/ 1	46/ 1	187/ 5	247/ 6									50.7	Lake LBJ
Squaw Creek	150				1,200/ 1	49/ 2	139/ 4	163/ 6	304/ 10			31/ 2	31/ 2					63.2	Lake LBJ
Threadgill Creek	151				1,200/ 1	49/ 2	139/ 4	163/ 6	304/ 10			31/ 2	31/ 2					63.5	Lake LBJ
James River	161				1,200/ 1	46/ 1	237/ 6	351/ 10	492/ 14			31/ 2	31/ 2					69.5	Lake LBJ
Mill Creek	164				1,200/ 1	46/ 1	222/ 5	351/ 10	492/ 14			31/ 2	31/ 2					71	Lake LBJ
Rocky Creek	166					46/ 1	46/ 1	351/ 9	492/ 14				31/ 2					95.1	Lake LBJ
Llano River	168					53/ 1	53/ 1	358/ 9	358/ 10				31/ 2					79.7	Lake LBJ
Unnamed Tributary (first-order)	173						84/ 3	2,651/18	2,704/19									116.3	Lake LBJ
Unnamed Tributary (first-order)	174						192/ 4	1,338/30	3,664/41							60/ 1	60/ 1	128	Lake LBJ
Unnamed Tributary (first-order)	175						76/ 5	1,227/31	3,513/40							60/ 1	60/ 1	129.8	Lake LBJ
Terret Draw	185			1,016/ 1	1,016/ 1		531/ 6	6,068/37	7,997/62						3/ 1	6/ 2	6/ 2		
Middle Valley	192			1,016/ 1	1,016/ 1		285/ 3	5,302/28	7,997/62						3/ 1	6/ 2	6/ 2		
Antelope Draw	197				1016/ 1		110/ 1	559/ 9	7,178/44						3/ 1	3/ 1	6/ 2		

Table 4-21. Ranking of Stream Crossings in Spill Transport Potential

Stream at Crossing	Map ID	Pipeline Crossing (MP)	Slope of Channel at Crossing	Basin Area (sq mi)	Stream Order	2-Year Flood (cfs)	Rank in Potential to Transport a Spill (1= highest)	Basis for Rank
Hunting Bayou	1	0.1	0.0006	14.4	urban	urban	4	Basin size
Greens Bayou	3	3.2, 6.0	0.0000	182	urban	urban	2	High Stream Order
Halls Bayou	8	13.2	0.0009	24.7	urban	urban	4	Basin size
Cypress Creek	34	47.1	0.0009	89.9	3	2701	2	High Stream Order
Unnamed Tributary to Crypress Creek	36	48.7	0.0010	3.9	2	311	5	Med-low 2-year flood
Mound Creek	37	50.4	0.0013	43.0	2	1,211	4	Med 2-year flood
Live Oak	38	53.9	0.0017	10.1	2	782	4	Med 2-year flood
Harris Creek Tributary	41	58.7	0.0033	7.5	2	576	5	Med-low 2-year flood
Harris Creek Tributary	42	59.7	0.0020	8.0		596	5	Med-low 2-year flood
Clear Creek[1]	44	62.6	0.0010	74.3	3	2,245	2	High Stream Order
Brazos River	45	64.0	0.00013	44,000	Major	57,800	1	Major Crossing
Muddy Branch	48	69.2	0.0022	9.2	2	1,172	4	Med 2-year flood
East Fork Mill Creek	57	81.2	0.0007	126.0	3	3,539	2	High Stream Order
Dogwood Creek	60	89.2	0.0025	11.1	2	988	4	Med 2-year flood
West Fork Mill Creek	61	90.8	0.0013	44.0	3	2,034	2	High Stream Order
Jacks Creek	67	98.3	0.0030	11.8	2	1,019	4	Med 2-year flood
Cummins Creek	68	99.2	0.0018	94.3	3	4,155	2	High Stream Order
Rabbs Creek	74	112.3	0.0013	81.3	3	4,366	2	High Stream Order
Knobbs Creek	77	118.8	0.0033	23.2	2	1,453	4	Med 2-year flood
Dreissner Branch	78	119.9	0.0033	6.8	2	761	5	Med-low 2-year flood
Pin Oak Creek	80	122.5	0.0014	50.1	3	3,668	2	High Stream Order
Gravelly Creek	81	123.0	0.0025	18.7	2	1,297	4	Med 2-year flood
JD Creek	82	126.7	0.0050	6.7	2	755	5	Med-low 2-year flood
Alum Creek	86	131.5	0.0028	46.1	3	3,884	2	High Stream Order
Little Alum Creek	87	132.3	0.0056	4.6	2	622	5	Med-low 2-year flood
Colorado River	89	134.5	0.00033	39.8	Major	48,300	1	Major Crossing
Unnamed	92	142.9	0.0048	7.3	2	691	5	Med-low 2-year flood
Cedar Creek[2]	93	142.8	0.0014	90	3	4,079	2	High Stream Order
Maha Creek[3]	97	151.7	0.0029	32.7	2	2,677	3	High 2-year flood
Dry Creek	99	157.4	0.0029	22.2	2	1,312	4	Med 2-year flood
Cottonmouth Creek	100	162.3	0.0040	2.2	1	324	5	Med-low 2-year flood
Marble Creek	101	163.5	0.0143	3.8	1	449	5	Med-low 2-year flood
Onion Creek	103	164.0	0.0014	284.4	Large	6,983	1	Major Crossing
Barton Creek	109	180.9	0.0050	40.9	2	2,392	3	High 2-year flood
Flat Creek	112	193.2	0.0091	31.0	3	1,919	2	High Stream Order
Pedernales River	115	198.8	0.0026	1,000.0	Large	15,488	1	Major Crossing
Cottonwood Creek	119	203.2	0.0111	10.3	2	901	4	Med 2-year flood
Hickory Creek	125	209.9	0.0063	12.2	2	1,024	4	Med 2-year flood
White Oak Creek	127	213.3	0.0100	7.5	2	829	4	Med 2-year flood
Crabapple Creek	135	229.3	0.0100	63.4	3	2,876	2	High Stream Order
Bernst Creek	140	237.8	0.0100	3.8	2	543	5	Med-low 2-year flood
Cherry Spring Creek	142	241.7	0.0040	11.0	2	1,011	4	Med 2-year flood
Marshall Creek	143	242.7	0.0059	10.9	2	947	4	Med 2-year flood
Squaw Creek	150	248.5	0.0063	39.6	2	2,231	3	High 2-year flood

Table 4-21. (Continued)

Stream at Crossing	Map ID	Pipeline Crossing (MP)	Slope of channel at crossing	Basin Area (sq mi)	Stream Order	2-Year Flood (cfs)	Rank in Potential to Transport a Spill (1= highest)	Basis for Rank
Threadgill Creek	151	250.0	0.0042	1,17.3	4	4,363	2	High Stream Order
James River	161	263.9	0.0029	322.1	Large	8,030	1	Major Crossing
Mill Creek	164	267.9	0.0067	7.3	2	786	4	Med 2-year flood
Rocky Creek	166	273.7	0.0100	10.5	2	993	4	Med 2-year flood
Llano River	168	276.5			Major		1	Major Crossing
Terret Draw	185	315.9	0.0028	34.6	3	1,711	3	High 2-year flood
Middle Valley	192	324.2	0.0011	137.2	3	3,545	3	High 2-year flood
Antelope Draw	197	334.3	0.0018	62.0	3	2,273	3	High 2-year flood
Big Lake Draw	211	402.6	0.0030	46.0	2	627	5	Med-low 2-year flood
Unnamed	216	415.8	0.0022	24.5	2	499	5	Med-low 2-year flood
China Draw	224	433.1	0.0026	17.1	2	374	5	Med-low 2-year flood
Mayfield Draw	234	450.2	0.0025	76.3	3	508	5	Med-low 2-year flood
Landreth Draw	239	458.3	0.0033	247.0	3	1,328	3	Med 2-year flood
Pecos River	250	525.6			Major		1	Major Crossing
Cottonwood Creek	254	556.6	0.0038	3,41.9	3	1,939	3	High 2-year flood
Cottonwood Creek	256	565.3	0.0071	247.5	3	1,348	4	Med 2-year flood
Cottonwood Creek	257	577.3	0.0077	63.4	2	877	4	Med 2-year flood
Frijole Draw	258	585.9	0.0143	7.8	2	291	5	Med-low 2-year flood
Burro Canyon	263	597.7	0.0091	8.8	2	104	6	Low 2-year flood
Cox Canyon	265	601.1	0.0100	21.2	2	234	6	Low 2-year flood
Unnamed	269	625.1	0.0100	16.2	2	1,989	3	High 2-year flood
Antelope Gulch	274	631.0	0.0043	797.8	Large	2,700	1	Major Crossing
Antelope Draw	282	651.3	0.0080	48.4	2	543	5	Med-low 2-year flood
Wildhorse	283	669.6	0.0091	83.3	2	695	5	Med-low 2-year flood
Middle Canyon	286	680.8	0.0032	9.5	2	426	5	Med-low 2-year flood
Fourmile Draw	287	684.0	0.0063	37.4	2	884	4	Med 2-year flood
Pow Wow Canyon	288	686.6	0.0133	46.2	2	347	5	Med-low 2-year flood

[1]Clear Creek does not cross the pipeline, but at one location parallels the pipeline at a distance of 85 meters.
[2]Cedar Creek does not cross the pipeline, but at one location parallels the pipeline at a distance of 320 meters.
[3]Maha Creek does not cross the pipeline, but at one location parallels the pipeline at a distance of 180 meters.

Table 4-22. Ranking of Stream Crossings in Spill Control Potential

Stream at Crossing	Map ID	Pipeline Crossing (MP)	Distance to Main Stem of River Downstream (mi)	Rank in Potential to Control a Spill (1= most difficult to control)	Basis for Rank
Hunting Bayou	1	0.1	N/A	6	In urban setting, within levees
Greens Bayou	3	3.2,6	N/A	6	In urban setting, within levees
Halls Bayou	8	13.2	N/A	6	In urban setting, within levees
Cypress Creek	34	47.1	0.0	1	Main stem
Unnamed Tributary to Crypress Creek	36	48.7	1.9	2	Within 2 miles of main stem
Mound Creek	37	50.4	7.5	3	3 to 10 miles from main stem
Live Oak	38	53.9	9.9	3	3 to 10 miles from main stem
Harris Creek Tributary	41	58.7	20.9	5	20-30 miles from main stem
Harris Creek Tributary	42	59.7	20.6	5	20-30 miles from main stem
Clear Creek[1]	44	62.6	1.2	2	Within 2 miles of main stem
Brazos River	45	64.0	0.0	1	Main stem
Muddy Branch	48	69.2	7.0	3	3 to 10 miles from main stem
East Fork Mill Creek	57	81.2	26.5	5	20-30 miles from main stem
Dogwood Creek	60	89.2	38.1	6	Over 35 miles from main stem
West Fork Mill Creek	61	90.8	38.7	6	Over 35 miles from main stem
Jacks Creek	67	98.3	37.0	6	Over 35 miles from main stem
Cummins Creek	68	99.2	36.9	6	Over 35 miles from main stem
Rabbs Creek	74	112.3	6.9	3	3 to 10 miles from main stem
Knobbs Creek	77	118.8	9.6	3	3 to 10 miles from main stem
Dreissner Branch	78	119.9	9.0	3	3 to 10 miles from main stem
Pin Oak Creek	80	122.5	9.6	3	3 to 10 miles from main stem
Gravelly Creek	81	123.0	9.8	3	3 to 10 miles from main stem
JD Creek	82	126.7	2.2	2	Near main stem
Alum Creek	86	131.5	3.3	2	On Colorado River Alluvium
Little Alum Creek	87	132.3	3.3	2	On Colorado River Alluvium
Colorado River	89	134.5	0.0	1	Main stem
Unnamed	92	142.9	13.2	2	On Colorado River Alluvium
Cedar Creek[2]	93	142.8	13.0	2	On Colorado River Alluvium
Maha Creek[3]	97	151.7	26.5	2	On Colorado River Alluvium
Dry Creek	99	157.4	14.9	4	10-20 miles from main stem
Cottonmouth Creek	100	162.3	4.0	3	3 to 10 miles from main stem
Marble Creek	101	163.5	0.2	1	Essentially at main stem
Onion Creek	103	164.0	15.3	1	Major tributary
Barton Creek	109	180.9	26.3	1	On Edwards/Balcones Contributing Zone
Flat Creek	112	193.2	3.8	3	3 to 10 miles from main stem
Pedernales River	115	198.8	33.2	1	Main stem, major tributary
Cottonwood Creek	119	203.2	1.2	2	Within 2 miles of main stem
Hickory Creek	125	209.9	2.6	2	Very near main stem
White Oak Creek	127	213.3	6.0	2	Near Ellenburger-San Saba Aquifer (karst)
Crabapple Creek	135	229.3	33.3	2	Near Ellenburger-San Saba Aquifer (karst)
Bernst Creek	140	237.8	22.7	5	20-30 miles from main stem

Table 4-22. (Continued)

Stream at Crossing	Map ID	Pipeline Crossing (MP)	Distance to Main Stem of River Downstream (mi)	Rank in Potential to Control a Spill (1= most difficult to control)	Basis for Rank
Cherry Spring Creek	142	241.7	21.6	5	20-30 miles from main stem
Marshall Creek	143	242.7	22.1	5	20-30 miles from main stem
Squaw Creek	150	248.5	14.2	1	On Ellenburger-San Saba Aquifer (karst)
Threadgill Creek	151	250.0	14.5	2	On Ellenburger-San Saba Aquifer (karst)
James River	161	263.9	9.1	1	Main stem, major tributary
Mill Creek	164	267.9	7.0	2	On Ellenburger-San Saba Aquifer (karst)
Rocky Creek	166	273.7	2.8	2	Near Ellenburger-San Saba Aquifer (karst)
Llano River	168	276.5	0.0	1	On Ellenburger-San Saba Aquifer (karst), major river
Terret Draw	185	315.9	9.5	2	On Edwards-Trinity (karst)
Middle Valley	192	324.2	14.9	2	On Edwards-Trinity (karst)
Antelope Draw	197	334.3	24.6	2	On Edwards-Trinity (karst)
Big Lake Draw	211	402.6	35.5	1	On Edwards-Trinity (karst), near known karst feature
Unnamed	216	415.8	40.3	2	Cenozoic Pecos Alluvium
China Draw	224	433.1	28.2	2	Cenozoic Pecos Alluvium
Mayfield Draw	234	450.2	22.6	2	Cenozoic Pecos Alluvium
Landreth Draw	239	458.3	16.8	2	Cenozoic Pecos Alluvium
Pecos River	250	525.6	0.0	2	Cenozoic Pecos Alluvium
Cottonwood Creek	254	556.6	43.1	2	Cenozoic Pecos Alluvium
Cottonwood Creek	256	565.3	53.1	2	Cenozoic Pecos Alluvium
Cottonwood Creek	257	577.3	57.0	6	Over 35 miles from main stem
Frijole Draw	258	585.9	67.6	6	Over 35 miles from main stem
Burro Canyon	263	597.7	4.0	6	Arid area
Cox Canyon	265	601.1	4.7	6	Arid area
Unnamed	269	625.1	9.8	6	Arid area
Antelope Gulch	274	631.0	21.3	6	Arid area
Antelope Draw	282	651.3	40.2	6	Arid area
Wildhorse	283	669.6	21.0	6	Arid area
Middle Canyon	286	680.8	19.0	6	Arid area
Fourmile Draw	287	684.0	16.1	6	Arid area
Pow Wow Canyon	288	686.6	15.0	6	Arid area
*Landreth Draw	1	1.5	17.6	2	Cenozoic Pecos Alluvium
*Landreth Draw	2	7.0	21.9	2	Cenozoic Pecos Alluvium

[1]Clear Creek does not cross the pipeline, but at one location parallels the pipeline at a distance of 85 meters.
[2]Cedar Creek does not cross the pipeline, but at one location parallels the pipeline at a distance of 320 meters.
[3]Maha Creek does not cross the pipeline, but at one location parallels the pipeline at a distance of 180 meters.
*Odessa Lateral.

Table 4-23. Ranking of Stream Crossings in Terms of Downstream Resource Importance as a Water Supply

Stream at Crossing	Map ID	Pipeline Crossing (MP)	Rank in Importance of Proximity and Type of Downstream Water Supply (1= most important)	Basis for Rank
Hunting Bayou	1	0.1	6	Low quality water
Greens Bayou	3	3.2, 6	6	Low quality water
Halls Bayou	8	13.2	6	Low quality water
Cypress Creek	34	47.1	3	Large irrigation right within 20 miles
Unnamed Tributary to Crypress Creek	36	48.7	3	Large irrigation right within 20 miles
Mound Creek	37	50.4	3	Large irrigation right within 20 miles
Live Oak	38	53.9	3	Large irrigation right within 20 miles
Harris Creek Tributary	41	58.7	2	Large irrigation right within 20 miles
Harris Creek Tributary	42	59.7	2	Large irrigation right within 20 miles
Clear Creek[1]	44	62.6	5	Small irrigation right within 20 miles
Brazos River	45	64.0	5	Small irrigation right within 20 miles
Muddy Branch	48	69.2	2	Municipal right within 75 miles downstream
East Fork Mill Creek	57	81.2	6	Small right, within 40/60 miles
Dogwood Creek	60	89.2	6	Small right, within 40/60 miles
West Fork Mill Creek	61	90.8	6	Small right, within 40/60 miles
Jacks Creek	67	98.3	6	Small right, within 40/60 miles
Cummins Creek	68	99.2	6	Small right, within 40/60 miles
Rabbs Creek	74	112.3	5	Small irrigation right within 20 miles
Knobbs Creek	77	118.8	5	Small irrigation right within 20 miles
Dreissner Branch	78	119.9	5	Small irrigation right within 20 miles
Pin Oak Creek	80	122.5	5	Small irrigation right within 20 miles
Gravelly Creek	81	123.0	5	Small irrigation right within 20 miles
JD Creek	82	126.7	5	On Colorado River Alluvium
Alum Creek	86	131.5	5	Alluvial irrigation well within 20 miles
Little Alum Creek	87	132.3	5	Alluvial irrigation well within 20 miles
Colorado River	89	134.5	5	Alluvial irrigation well within 20 miles
Unnamed	92	142.9	5	Alluvial irrigation well within 20 miles
Cedar Creek[2]	93	142.8	5	Alluvial irrigation well within 20 miles
Maha Creek[3]	97	151.7	5	Alluvial irrigation well within 20 miles
Dry Creek	99	157.4	1	14.9 miles to Colorado River Alluvium
Cottonmouth Creek	100	162.3	1	12.7 miles to Colorado River Alluvium
Marble Creek	101	163.5	1	13.7 miles to Colorado River Alluvium
Onion Creek	103	164.0	1	15.3 miles to Colorado River Alluvium
Barton Creek	109	180.9	1	26.3 miles to Edwards/Balcones recharge
Flat Creek	112	193.2	1	Highland Lake within 40 miles downstream
Pedernales River	115	198.8	1	Highland Lake within 40 miles downstream
Cottonwood Creek	119	203.2	2	Highland Lake within 75 miles downstream
Hickory Creek	125	209.9	2	Highland Lake within 75 miles downstream
White Oak Creek	127	213.3	2	Highland Lake within 75 miles downstream
Crabapple Creek	135	229.3	2	Highland Lake within 75 miles downstream
Sandy Creek (1)	138	234.9	1	Alluvial public water supply well within 2 mi
Sandy Creek (2)	139	236.6	1	Alluvial public water supply well within 2 mi
Bernst Creek	140	237.8	1	Highland Lake within 40 miles downstream

Table 4-23. (Continued)

Stream at Crossing	Map ID	Pipeline Crossing (MP)	Rank in Importance of Proximity and Type of Downstream Water Supply (1= most important)	Basis for Rank
Cherry Spring Creek	142	241.7	2	Highland Lake within 40 miles downstream
Marshall Creek	143	242.7	2	Highland Lake within 75 miles downstream
Squaw Creek	150	248.5	2	Highland Lake within 75 miles downstream
Threadgill Creek	151	250.0	2	Highland Lake within 75 miles downstream
James River	161	263.9	2	Highland Lake within 75 miles downstream
Mill Creek	164	267.9	2	Highland Lake within 75 miles downstream
Rocky Creek	166	273.7	5	Small irrigation right within 20 miles
Llano River	168	276.5	5	Small irrigation right within 20 miles
Terret Draw	185	315.9	2	Alluvial public water supply well within 60 mi
Middle Valley	192	324.2	4	Large irrigation right within 40 miles
Antelope Draw	197	334.3	4	Large irrigation right within 40 miles
Big Lake Draw	211	402.6	7	No uses identified within 60 miles
Unnamed	216	415.8	7	No uses identified within 60 miles
China Draw	224	433.1	7	No uses identified within 60 miles
Mayfield Draw	234	450.2	7	No uses identified within 60 miles
Landreth Draw	239	458.3	7	No uses identified within 60 miles
Pecos River	250	525.6	7	No uses identified within 60 miles
Cottonwood Creek	254	556.6	7	No uses identified within 60 miles
Cottonwood Creek	256	565.3	7	No uses identified within 60 miles
Cottonwood Creek	257	577.3	7	No uses identified within 60 miles
Frijole Draw	258	585.9	7	No uses identified within 60 miles
Burro Canyon	263	597.7	7	No uses identified within 60 miles
Cox Canyon	265	601.1	7	No uses identified within 60 miles
Unnamed	269	625.1	7	No uses identified within 60 miles
Antelope Gulch	274	631.0	7	No uses identified within 60 miles
Antelope Draw	282	651.3	7	No uses identified within 60 miles
Wildhorse	283	669.6	7	No uses identified within 60 miles
Middle Canyon	286	680.8	7	No uses identified within 60 miles
Fourmile Draw	287	684.0	7	No uses identified within 60 miles
Pow Wow Canyon	288	686.6	7	No uses identified within 60 miles
*Landreth Draw	1	1.5	7	No uses identified within 60 miles
*Landreth Draw	2	7.0	7	No uses identified within 60 miles

[1]Clear Creek does not cross the pipeline, but at one location parallels the pipeline at a distance of 85 meters.
[2]Cedar Creek does not cross the pipeline, but at one location parallels the pipeline at a distance of 320 meters.
[3]Maha Creek does not cross the pipeline, but at one location parallels the pipeline at a distance of 180 meters.
*Odessa Lateral.

Table 4-24. Summary of Sensitivity Rankings, Surface Water Crossings

Stream at Crossing	Map ID	Pipeline Station for Crossing (mi)	Rank in Importance of Proximity and Type of Downstream Water Supply (1= most important)	Rank in Potential to Control a Spill (1= most difficult to control)	Rank in Potential to Transport a Spill (1= highest)	Sum of Ranks
Onion Creek	103	164.0	1	1	1	3
Pedernales River	115	198.8	1	1	1	3
James River	161	263.9	2	1	1	4
Barton Creek	109	180.9	1	1	3	5
Threadgill Creek	151	250.0	2	1	2	5
Cypress Creek	34	47.1	3	1	2	6
Flat Creek	112	193.2	1	3	2	6
Crabapple Creek	135	229.3	2	2	2	6
Squaw Creek	150	248.5	2	1	3	6
Terret Draw	185	315.9	2	1	3	6
Brazos River	45	64.0	5	1	1	7
Colorado River	89	134.5	5	1	1	7
Mill Creek	164	267.9	2	1	4	7
Llano River	168	276.5	5	1	1	7
Alum Creek	86	131.5	5	1	2	8
Cedar Creek[2]	93	142.8	5	1	2	8
Cottonwood Creek	119	203.2	2	2	4	8
Hickory Creek	125	209.9	2	2	4	8
White Oak Creek	127	213.3	2	2	4	8
Middle Valley	192	324.2	4	1	3	8
Antelope Draw	197	334.3	4	1	3	8
Clear Creek[3]	44	62.6	5	2	2	9
Muddy Branch	48	69.2	2	3	4	9
Maha Creek[1]	97	151.7	5	1	3	9
Dry Creek	99	157.4	1	4	4	9
Pecos River	250	525.6	7	1	1	9
Unnamed Trib to Crypress Creek	36	48.7	3	2	5	10
Mound Creek	37	50.4	3	3	4	10
Live Oak	38	53.9	3	3	4	10
Rabbs Creek	74	112.3	5	3	2	10
Pin Oak Creek	80	122.5	5	3	2	10
Cottonmouth Creek	100	162.3	1	4	5	10
Marble Creek	101	163.5	1	4	5	10
JD Creek	82	126.7	5	1	5	11
Little Alum Creek	87	132.3	5	1	5	11
Unnamed	92	142.9	5	1	5	11
Sandy Creek (1)	138	234.9	1	5	5	11
Sandy Creek (2)	139	236.6	1	5	5	11
Bernst Creek	140	237.8	1	5	5	11
Cherry Spring Creek	142	241.7	2	5	4	11
Marshall Creek	143	242.7	2	5	4	11

Table 4-24. (Continued)

Stream at Crossing	Map ID	Pipeline Station for Crossing (mi)	Rank in Importance of Proximity and Type of Downstream Water Supply (1= most important)	Rank in Potential to Control a Spill (1= most difficult to control)	Rank in Potential to Transport a Spill (1= highest)	Sum of Ranks
Rocky Creek	166	273.7	5	2	4	11
Landreth Draw	239	281.8	7	1	3	11
Cottonwood Creek	254	556.6	7	1	3	11
Harris Creek Trib	41	58.7	2	5	5	12
Harris Creek Trib	42	59.7	2	5	5	12
Knobbs Creek	77	118.8	5	3	4	12
Gravelly Creek	81	123.0	5	3	4	12
Cottonwood Creek	256	565.3	7	1	4	12
East Fork Mill Creek	57	81.2	6	5	2	13
Dreissner Branch	78	119.9	5	3	5	13
Big Lake Draw	211	402.6	7	1	5	13
Unnamed	216	415.8	7	1	5	13
China Draw	224	433.1	7	1	5	13
Mayfield Draw	234	450.2	7	1	5	13
West Fork Mill Creek	61	90.8	6	6	2	14
Cummins Creek	68	99.2	6	6	2	14
Antelope Gulch	274	631.0	7	6	1	14
Greens Bayou	3		6	6	2	14
Dogwood Creek	60	89.2	6	6	4	16
Jacks Creek	67	98.3	6	6	4	16
Unnamed	269	625.1	7	6	3	16
Hunting Bayou	1		6	6	4	16
Halls Bayou	8		6	6	4	16
Cottonwood Creek	257	577.3	7	6	4	17
Fourmile Draw	287	684.0	7	6	4	17
Frijole Draw	258	585.9	7	6	5	18
Antelope Draw	282	651.3	7	6	5	18
Wildhorse	283	669.6	7	6	5	18
Middle Canyon	286	680.8	7	6	5	18
Pow Wow Canyon	288	686.6	7	6	5	18
Burro Canyon	263	597.7	7	6	6	19
Cox Canyon	265	601.1	7	6	6	19
*Landreth Draw	1	1.5	4	2	7	13
*Landreth Draw	2	7.0	4	2	7	13

[1]Clear Creek does not cross the pipeline, but at one location parallels the pipeline at a distance of 85 m.
[2]Cedar Creek does not cross the pipeline, but at one location parallels the pipeline at a distance of 320 m.
[3]Maha Creek does not cross the pipeline, but at one location parallels the pipeline at a distance of 180 m.
*Odessa Lateral.

Table 4-25. Summary of Pipeline Stream Crossings and Upstream Watersheds, Re-route Crossings

Stream at Crossing	Map ID	Pipeline Station for Crossing (mi)	Basin Area (sq mi)	Stream Order	2-Year Flood	100-Year Flood	Rank in Potential to Transport a Spill (1= highest)	Basis for Rank
Cottonmouth	1	2.2	0.71	1	126	1,208	6	Low 2-year flood
Marble	2	3.8	1.65	1	224	2,442	6	Low 2-year flood
Rinard	3	5.4	3.57	2	378	4,707	5	Med-low 2-year flood
Unnamed trib, Rinard	4	6.3	2.95	1	332	3,721	5	Med-low 2-year flood
Unnamed trib, Rinard	5	7.2	1.42	1	202	1,963	6	Low 2-year flood
Onion	6	9.2	169.51	Large	4,858	40,871	1	Major Crossing
Garlic	7	10.1	4.97	1	473	6,122	5	Med-low 2-year flood
Little Bear	8	11.7	20.22	2	1,228	24,980	4	Med 2-year flood
Little Bear	9	12.8	18.09	2	1,139	22,426	4	Med 2-year flood
Little Bear	10	14.5	11.77	2	850	15,663	4	Med 2-year flood
Unnamed trib, Little Bear	11	16.0	1.50	1	209	2,827	6	Low 2-year flood
Bear	12	17.6	19.63	3	1,204	28,497	2	High Stream Order
Unnamed trib, Slaughter	13	18.6	2.18	1	270	3,617	6	Low 2-year flood
Slaughter	14	20.7	9.65	2	743	13,595	5	Med-low 2-year flood

Table 4-26. Ranking of Stream Crossings in Spill Control Potential, Re-route Crossings

Stream at Crossing	Map ID	Pipeline Station for Crossing (mi)	Distance to Main Stem of River Downstream (mi)	Rank in Potential to Control a Spill (1= most difficult to control)	Basis for Rank
Cottonmouth	1	2.2	5.0	3	3 to 10 miles from main stem
Marble	2	3.8	3.7	3	3 to 10 miles from main stem
Rinard	3	5.4	1.9	2	Within 2 miles of main stem
Unnamed trib, Rinard	4	6.3	3.1	3	3 to 10 miles from main stem
Unnamed trib, Rinard	5	7.2	4.0	3	3 to 10 miles from main stem
Onion	6	9.2	0	1	On main stem
Garlic	7	10.1	0.6	2	Within 2 miles of main stem
Little Bear	8	11.7	4.0	3	3 to 10 miles from main stem
Little Bear	9	12.8	5.0	1	Karst (Person) formation (leached and collapsed)
Little Bear	10	14.5	7.8	1	Karst (evaporite) member
Unnamed trib, Little Bear	11	16.0	8.7	1	Karst (Kainer) formation member
Bear	12	17.6	6.8	3	3 to 10 miles from main stem
Unnamed trib, Slaughter	13	18.6	11.2	1	Karst (Kainer) formation member
Slaughter	14	20.7	11.8	1	Karst (Kainer) formation member

Table 4-27. Ranking of Stream Crossings in Terms of Downstream Resource Importance as a Water Supply, Re-route Crossings

Stream at Crossing	Map ID	Pipeline Station for Crossing (mi)	Rank in Importance of Proximity and Type of Downstream Water Supply (1= most important)	Basis for Rank
Cottonmouth	1	2.2	1	15 miles to Colorado River Alluvium
Marble	2	3.8	1	17 miles to Colorado River Alluvium
Rinard	3	5.4	1	21 miles to Colorado River Alluvium
Unnamed trib, Rinard	4	6.3	1	22 miles to Colorado River Alluvium
Unnamed trib, Rinard	5	7.2	1	24 miles to Colorado River Alluvium
Onion	6	9.2	1	Small municipal right within 10 miles
Garlic	7	10.1	1	Small municipal right within 10 miles
Little Bear	8	11.7	1	Small municipal right within 10 miles
Little Bear	9	12.8	1	Small municipal right within 10 miles
Little Bear	10	14.5	1	Small municipal right within 10 miles
Unnamed trib, Little Bear	11	16.0	1	Small municipal right within 10 miles
Bear	12	17.6	1	Small municipal right within 10 miles
Unnamed trib, Slaughter	13	18.6	1	30 miles to Colorado River Alluvium
Slaughter	14	20.7	1	29 miles to Colorado River Alluvium

Table 4-28. Summary of Sensitivity Ranking, Re-route Crossings

Stream at Crossing	Map ID	Pipeline Station for Crossing (mi)	Rank in Importance of Proximity and Type of Downstream Water Supply (1= most important)	Rank in Potential to Control a Spill (1= most difficult to control)	Rank in Potential to Transport a Spill (1= highest)	Sum of Ranks
Onion	6	9.2	1	3	1	5
Bear	12	17.6	1	3	2	6
Little Bear	8	11.7	1	2	4	7
Rinard	3	5.4	1	1	5	7
Slaughter	14	20.7	1	1	5	7
Little Bear	9	12.8	1	3	4	8
Little Bear	10	14.5	1	3	4	8
Unnamed trib, Rinard	4	6.3	1	2	5	8
Cottonmouth	1	2.2	1	1	6	8
Marble	2	3.8	1	1	6	8
Unnamed trib, Little Bear	11	16.0	1	1	6	8
Unnamed trib, Slaughter	13	18.6	1	1	6	8
Garlic	7	10.1	1	3	5	9
Unnamed trib, Rinard	5	7.2	1	3	6	10

Table 4-29. Common Fish Species in Surface Water Features Crossed by the Longhorn Pipeline

Species	Upper Pecos River	Llano River	Barton Creek	Pedernales River	Onion Creek	Cypress Creek	Greens Bayou	Whiteoak Bayou	Brazos River	Colorado River
Largemouth bass (*Micropterus salmoides*)	X	X	X		X	X	X	X	X	X
White bass (*Morone chrysops*)	X									
Guadalupe bass (*Micropterus treculi*)		X	X		X					X
Smallmouth bass (*Micropterus dolomieui*)				X						
Channel catfish (*Ictalurus punctatus*)		X				X			X	X
Flathead catfish (*Pilodictus olivaris*)	X	X							X	X
Green sunfish (*Lepomis cyanellus*)		X	X	X	X	X		X	X	X
Longear sunfish (*Lepomis megalotis*)		X	X	X	X	X	X			X
Freshwater drum (*Aplodinotus grunniens*)									X	

Table 4-30. Threatened, Endangered, and Candidate Species Potentially Affected by Longhorn Pipeline

Common Name	Scientific Name	Status	Counties of Occurrence	Vegetation Regions
Avian Species				
Attwater's Greater Prairie Chicken	*Tympanuchus cupido attwateri*	FE, SE	Austin	Gulf Coast Prairies and Marshes
Bald Eagle	*Haliaeetus leucocephalus*	FT, ST	Austin, Bastrop, Fayette, Gillespie, Harris, Waller	Gulf Coast Prairies and Marshes, Oak Woodlands and Prairies, Blackland Prairies, Llano Uplift
Interior Least Tern	*Sterna antillarum athalassos*	FE, SE	Bastrop, Blanco, Crockett, Fayette, Gillespie, Kimble, Mason, Menard, Reagan, Schleicher	Gulf Coast Prairies and Marshes, Oak Woodlands and Prairies, Blackland Praries, Edwards Plateau, Llano Uplift
Black-capped Vireo	*Vireo atricapillus*	FE, SE	Blanco, Crockett, Gillespie, Hays, Kimble Menard, Reagan, Schleicher, Terrell, Travis, Upton	Edwards Plateau, Llano Uplift
Golden-cheeked Warbler	*Dendroica chrysoparia*	FE, SE	Blanco, Gillespie, Hays, Kimble, Mason, Menard, Travis	Edwards Plateau, Llano Uplift
Southwestern Willow Flycatcher	*Empidonax traillii extimus*	FE, SE	Hudspeth, Culberson, El Paso	Trans-Pecos
Aquatic Species				
Barton Springs Salamander	*Eurycea sosorum*	FE, SE	Travis	Edwards Plateau (Barton Springs)
Texas Blind Salamander	*Typhlomolge rathbuni*	FE, SE	Hays	Edwards Plateau (karst formations)
Devil's River Minnow	*Dionda diaboli*	FC, ST	Val Verde	Trans-Pecos
Pecos Pupfish	*Cyprinodon pecosensis*	FP/E, ST	Crockett, Crane, Culberson, Reeves, Ward	Trans-Pecos
Amphibian Species				
Houston Toad	*Bufo houstonensis*	FE, SE	Austin, Bastrop, Lee	Lost Pines, Piney Woods
Plant Species				
Texas Prairie-dawn	*Hymenoxys texana*	FE, SE	Harris, Waller	Gulf Coast Prairies and Marshes
Navasota Ladies'-tresses	*Spiranthes parksii*	FE, SE	Fayette	Oak Woodlands and Prairies
Tobusch Fishhook Cactus	*Ancistrocactus tobuschii*	FE, SE	Kimble	Edwards Plateau
Texas Snowbells	Styrax texana	FE, SE	Kimble	Edwards Plateau
Puzzle Sunflower	*Helianthus paradoxus*	FC, ST	Reeves	Trans-Pecos
Guadalupe Fescue	*Festuca ligulata*	FC	Culberson	Trans-Pecos
Gypsum Wild-buckwheat	*Eriogonum gypsophilum*	FT	Culberson	Trans-Pecos
Sneed Pincushion Cactus	*Coryphantha sneedii* var. *sneedii*	FE, SE	El Paso	Trans-Pecos

Table 4-30. (Continued)

Common Name	Scientific Name	Status	Counties of Occurrence	Vegetation Regions
Invertebrates				
Bee Creek Cave Harvestman	*Texella reddelli*	FE	Travis	Edwards Plateau (karst formations)
Bone Cave Harvestman	*Texella reyesi*	FE	Travis	Edwards Plateau (karst formations)
Kretschmarr Cave Mold Beetle	*Texamaurops reddelli*	FE	Travis	Edwards Plateau (karst formations)
Tooth Cave Ground Beetle	*Rhadine persephone*	FE	Travis	Edwards Plateau (karst formations)
Tooth Cave Pseudoscorpion	*Tartarocreagris texana*	FE	Travis	Edwards Plateau (karst formations)
Tooth Cave Spider	*Neoleptoneta myopica*	FE	Travis	Edwards Plateau (karst formations)

Abbreviations:

FE Federally-listed as Endangered
FT Federally-listed as Threatened
FP/E Federally-proposed as Endangered
FP/T Federally-proposed as Threatened
FC Candidate for Federal listing as either threatened or endangered
SE State-listed as Endangered
ST State-listed as Threatened

Note: Texas Blind Salamander, Bee Creek Cave Harvestman, Bone Cave Harvestman, Kretschmarr Cave Mold Beetle, Tooth Cave Pseudoscorpion, and Tooth Cave Spider are endemic of karst formation caves within the Edwards Plateau. Although known populations are not within the area crossed by Longhorn pipeline, the species were included in the list due to the potential presence of these and similar (potentially undiscovered) species.

Sources:
U.S. Fish and Wildlife Service, 1995
U.S. Fish and Wildlife Service, 1998
Texas Parks and Wildlife Department - dated and undated literature entitled: Barton Springs Salamander, Karst Invertebrates, Golden-cheeked Warbler, Black-capped Vireo, and Edwards Aquifer Species.

Table 4-31. Protected Species

AVIAN SPECIES
Attwater's Prairie Chicken: Attwater's Prairie Chicken is a terrestrial, heavy-bodied, mostly seed- and fruit-eating bird that is part of the Family *Phaisianidae*. The known population of Attwater's Prairie Chicken is limited to Austin County, more than 20 miles south of the pipeline corridor; There are no known populations north of the pipeline. The species is an endemic race of formerly ranged throughout the Great Plains from central Canada to south Texas. The population is currently estimated at 1,000 individuals (Rappole and Blacklock, 1994). Habitat requirements include a mixture of short, mid, and tall grass prairie for courtship, feeding, shelter, and nesting. Short grasses are used for courtship, feeding, and to avoid moisture from heavy dew or rain. Mid-length grassy areas are used for roosting and feeding. Tall grasses are needed for nesting, feeding, and as escape cover (USFWS, 1995). The birds prefer open prairies without woody cover and avoid areas with more than moderate shrub cover (Terres, 1996).
Bald Eagle: The Bald Eagle is a large raptor with an expansive (6-7 feet) wingspan and unfeathered feet. The current range of the Bald Eagle in Texas includes the central portion of the state, generally near large rivers and reservoirs. Nests are often located in areas where forest, marsh, and water meet. Large, tall trees (40- to 120-foot) that are taller than the general forest canopy are used for nesting and roosting. Tree species used for nesting in Texas include loblolly pine, bald cypress, oak, cottonwood, and sycamore. Eagles are associated with aquatic ecosystems throughout most of their range and fish are their primary food. Eagles also prey on waterfowl, turtles, small mammals, and carrion (EPA, 1993). Although it is unlikely that pipeline operations, maintenance, or repair activities would directly affect eagle populations, an accidental release of product to a major body of water that is used by eagle populations for feeding (fishing) could reduce prey availability and/or result in poisoning of individuals.
Interior Least Tern: The Least Tern is a migratory species with a current summer distribution along the Red River from Louisiana to the Panhandle, along the Canadian River (in the Panhandle), the upper Trinity River, and several waterways within central Texas. Winter distribution is limited to the Texas coast. Habitat requirements for the species are primarily based on the presence of bare or nearly bare ground and alluvial islands for nesting, availability of food (primarily small fish), and favorable water levels during the nesting season. Preferred nesting sites are salt flats along lake shorelines, broad sandbars, and barren shores within wide, unobstructed river channels.
Black-capped Vireo: The Black-capped Vireo is a small migratory songbird. In Texas, vireo habitat is found on rocky limestone soils of the Edwards Plateau, eastern Trans-Pecos, and to a limited extent, on igneous soil in the Chisos Mountains. Vireos require vegetation reaching to ground level for nesting cover and typically nest in shrublands and open woodlands with a distinctive patchy structure. Typical habitat is characterized by shrubs extending from the ground to about 6 feet and covering 30 to 60 percent or greater of the total area. In typical habitat, open grassland separates clumps of shrubs and trees (TPWD, various dates).
Golden-cheeked Warbler: The Golden–cheeked Warbler is a small (4.5 to 5 inches long), migratory songbird, with a wingspan of about 8 inches. Typical nesting habitat consists of tall, thick, mature stands of Ashe juniper (cedar) mixed with hardwoods such as Texas (Spanish) oak, Lacey oak, shin (scalybark) oak, live oak, post oak, Texas ash, cedar elm, hackberry, bigtooth maple, sycamore, Arizona walnut, escarpment cherry, and pecan. Preferred habitat typically is within relatively moist areas such as steep sided canyons and slopes; however, suitable habitat also occurs in drier, upland juniper-oak (i.e. live oak, post oak, blackjack oak) woodlands over flat topography. The range and distribution of the species in Texas is largely limited to the Edwards Plateau, including Blanco, Gillespie, Hays, Kimble, Mason, Menard, and Travis counties (TPWD, various dates).
Southwestern Willow Flycatcher: The Southwestern Willow Flycatcher, is a small neotropical migratory species with a present breeding range extending from southern California, southern Nevada, southern Utah, Arizona, New Mexico, western Texas, southwestern Colorado, and extreme northwestern Mexico. Its range and distribution in Texas includes the Pecos River basin and Hudspeth, Culberson, and El Paso counties. Habitat requirements include dense riparian associations of willow, cottonwood, buttonbush, tamarisk, baccharis, and other deciduous shrubs and trees. Consequently, the species is indigenous to rivers, streams, and woodlands that are widely separated by expanses of arid lands (USFWS, 1995).

Table 4-31. (Continued)

AQUATIC SPECIES
Barton Springs Salamander: The Barton Springs Salamander is a rare endemic to Barton Springs, in Austin. The species is entirely aquatic throughout its life and occurs only at the outflows of the springs in water depths from several inches to 15 feet. The salamander is known to consume amphipods and other small aquatic crustaceans (TPWD, various dates). Preservation of the species is contingent upon a continuous and ample supply of fresh water to the Barton Springs pool and the adjacent Eliza Springs pool. Although populations of the species was abundant in both pools during the early 1970s, their numbers have decreased sharply as a result of the removal of aquatic vegetation and other factors.
***Texas Blind Salamander:** The Texas Blind Salamander is a troglobitic species that is endemic to San Marcos Pool of the Edwards Aquifer in Hays County. Although the species is not likely to be affected by operations, maintenance, or an accidental release of product from Longhorn, it was included in the inventory of federally-listed species as representative of other similar species that may be present in karst formations elsewhere along the pipeline alignment. Threats to the Texas Blind Salamander (and other troglobitic species) are directly related to changes in the Edwards Aquifer as a result of increased water usage and contaminants and pollution associated with urbanization (TPWD, various dates).
Devil's River Minnow: Devil's River Minnow is a rare endemic species that inhabits rocky runs and flowing pools in south Texas. Historically, the species was known from the Devil's River, San Felipe, and Sycamore creeks in Val Verde County and Las Moras Creek in Kinney County. Presently known populations are limited to the Val Verde County creeks and possibly two small streams in Mexico. The Kinney County population apparently has been extirpated. Recent and ongoing impacts to the species includes reduced flows within creeks and streams as a result of ground water pumpage and loss of habitat as a result of Amistad Reservoir. Those populations that remain viable in the United States are approximately 100 miles down stream from creeks and tributaries that are crossed by Longhorn pipeline.
Pecos Pupfish: The Pecos Pupfish is endemic to saline waters that support few other species of fish. Populations of the Pecos Pupfish are currently believed to be restricted to a limited reach of the Pecos River and isolated off-channel habitats within the Pecos River Basin in New Mexico; the upper reaches of Salt Creek, Culberson and Reeves counties, Texas; and in two water-filled gravel pits in Pecos County, Texas (University of Texas, 1998). The Longhorn pipeline is not within the sub-watersheds of the known populations of the Pecos pupfish; however, populations are known to occur within off-channel waters, downstream of the pipeline crossing.
AMPHIBIAN SPECIES
Houston Toad: The Houston Toad is an endemic of the Lost Pines of Bastrop County and piney woods of several southeast Texas counties. The species is a terrestrial amphibian associated with deep sandy soils. For breeding and tad-pole development, Houston toads also require still or slow-moving bodies of water that persist for at least 30 days. The source of ephemeral or persistent water should be located within one-half to three-quarters mile of the toad's hibernation/foraging habitat (deep sands supporting woodlands or savannah). Critical habitat was desig-nated for the Houston toad in January 1978. A portion of this habitat in Bastrop County is traversed by the Longhorn pipeline. Habitat assessment surveys conducted along an adjacent pipeline reported minimal potential habitat being found and no individuals being encountered (Horizon Environmental, 1991). Personal communi-cations with Brent Leisure, Park Manager for Bastrop and Buescher State Parks also confirmed that Houston Toad habitat within the portion of Buescher State Park that is crossed by the pipeline is marginal.

Table 4-31. (Continued)

PLANTS
Texas Prairie Dawn: Texas Prairie Dawn is a small, delicate annual with single or branching stems. Blooms are small yellow flowers coming in late-March to early-April. The species grows in sparsely vegetated areas with fine, sandy soil, specifically in the northern part of the Gulf Coastal Prairie. It is found in poorly drained depressions or saline swales around the periphery of low, natural mounds (mima mounds) in open grasslands. These mostly barren areas are sparsely vegetated and the soil often supports a blue-green alga (*Nostoc* sp.). It can also occur on disturbed areas such as rice fields, vacant lots, and pastures if the soil structure remains relatively intact (USFWS, 1995).
Navasota Ladies'-tresses Navasota Ladies'-tresses is an orchid that is found in moist sandy soils in small openings amongst post oak savanna. The present range and distribution of the species is limited to the Navasota, Trinity, and Brazos River drainages.
Tobusch Fishhook Cactus: This plant is a rounded, biscuit shaped cacti usually 2-3 inches tall and up to 3.5 inches in diameter. There are 3-5 central spines with the upper 2-3 erect and straight and the lower central spines hooked at the tip and spreading. This cactus occurs on limestone gravels of stream terraces, limestone ledges, ridges, and opening in the rocky hills of live oak juniper woodlands (USFWS, 1995). The Tobusch fishhook cactus has been documented in Kimble County. Habitat assessment surveys conducted along an adjacent pipeline reported minimal potential habitat being found and no individuals being encountered (Horizon Environmental, 1991).
Texas Snowbells: This plant is a deciduous shrub reaching up to 15 feet tall. It has alternate leaves that are nearly round with smooth margins, bright green above, and silvery underneath. They have bright, shiny, white, bell-shaped flowers. The species is endemic to limestone bluffs and cliff faces along rivers, streams, or dry beds in the Edward's Plateau (USFWS, 1995).
Puzzle Sunflower: Puzzle sunflower is superficially similar to several other sunflower species, but the combination of glabrous stems, strongly three-nerved lanceolate leaves, ovate-lanceolate to lanceolate phyllaries, along with its fall flowering period, distinguish it. Habitat for the species is moist heavy alkaline/saline calcareous silty clays and loams in and around cienagas (desert springs) (USFWS, 1995).
Guadalupe Fescue: The Guadalupe Fescue has long (3-4 mm) ligules, few-flowered panicles, and awnless spikelets. Woodlands on mesic slopes and in creek bottoms above 6,000 feet in the Guadalupe and Chisos Mountains. Habitat requirements consist of gravelly and sandy loams, derived from igneous materials in the Chisos Mountains and the Guadalupe Mountains (Personal Communication, Shannon Breslin).
Gypsum Wild-buckwheat: The gypsum wild-buckwheat is a small perennial herb. The flower is bright yellow, with conspicuous greenish midrib on each segment. The species is found on eroded hillsides and tops of gypsum beds or alluvial fans. Average altitude of known habitats is 3,300 feet (USFWS, 1995).
Sneed Pincushion Cactus: The Sneed pincushion cactus is a multi-branched cactus that forms clumps measuring over a foot in diameter, often comprised of up to 100 stems. The flowers are magenta and the fruits are fleshy and green. It tends to inhabit the limestone ledges in the Chihuahuan Desert and grasslands between 3,900 to 7,000 feet in elevation. Associated vegetation includes creosote bush, ocotillo, lechuguilla, beargrass, and other species of cacti (USFWS, 1995).
INVERTEBRATES*
Bee Creek Cave Harvestman: The Bee Creek Cave Harvestman is a small arachnid with a body length of 2 to 3 mm and relatively long legs (commonly called "daddy-longlegs"). It has no eyes, and is often found in dark areas under rocks or in caves and karst features. These arachnids cannot tolerate prolonged periods of food and water deprivation, as can many spiders. The present known distribution of the Bee Creek Cave Harvestman is limited to the Rollingwood area south of the Colorado River, the Jollyville Plateau, and near Spicewood in Burnet County (TPWD, Various Dates; USFWS, 1995).

Table 4-31. (Continued)

Bone Cave Harvestman: This invertebrate is another small bodied, long legged blind arachnid. The average body length is 1.4 to 2.7 mm. The Bone Cave Harvestman is a pale orange and is especially sensitive to humidity levels below saturation. The Bone Cave Harvestman can be found in dark moist places. The present distribution of the species is described by the USFWS (1995) as Travis and Williamson counties.
Kretschmarr Cave Mold Beetle: This small beetle has short wings and lacks eyes. It lives in complete darkness, under and among rocks or buried in the ground silt of karst formations. Little is known of the mold beetle, but it is believed to be a predator and is considered extremely rare. Its presently known distribution is limited to the Jollyville Plateau, in Travis County (USFWS, 1995).
Tooth Cave Ground Beetle: The cave ground beetle is a troglodyte with vestigial eyes and a highly active lifestyle. It is an actively foraging omnivore that feeds on cave cricket eggs and microarthropods. It appears to prefer damp areas of deep, uncompacted silt. The presently known distribution of the species is described by the USFWS (1995) as the Jollyville Plateau and Cedar Park areas of Travis and Williamson counties.
Tooth Cave Pseudoscorpion: The Tooth Cave Pseudoscorpion resembles a small, tailless scorpion. It has the traditional trogloditic feature of vestigial eyes. It feeds primarily on microarthropods and is quite rare. The USFWS (1995) describes the presently known distribution of the species as karst formations in the Jollyville Plateau of Travis County.
Tooth Cave Spider: The Tooth Cave Spider is small (1.6 mm), pale colored, long-legged, with reduced eyes. The species has been found in damp, but not flooded karst formations. Its presently known distribution is described by the USFWS (1995) as the Jollyville Plateau in Travis County.

*Protected species that are known to inhabit karst formation caves in the Edwards-BFZ. Although it is unlikely that they would be affected by an accidental release of product, they have been included in the listing of threatened and endangered species to represent yet undiscovered troglodyte species and populations that may exist in karst formations along the pipeline.

Sources:
Garrett et al., 1992
Rappole and Blacklock, 1994
Texas Parks and Wildlife Department, undated literature entitled: Barton Springs Salamander, Karst Invertebrates, Golden-cheeked Warbler, Black-capped Vireo, and Houston Toad
Texas Parks and Wildlife Department, Endangered Resources Branch: various county listings
U.S. Fish and Wildlife Service, 1995